

SONY®

SERVICE MANUAL

VO-1600

VIDEOCASSETTE RECORDER

1st Revision

SONY CORPORATION

© 1972

Dub channel 1 only

ALT-21

Isolation

transformer

for old V0-1600

get rid

of Analog

Grand loop nam

1-10. CLEANING THE VIDEO HEADS

Partial erasure of the picture, the appearance of snow or streaks in the playback picture may indicate the need for cleaning of the video heads. This is accomplished with the Cleaning Cassette as follows:

1. Insert the Cleaning Cassette into the Cassette compartment as you would a VIDEO-CASSETTE.
2. Reset the tape counter to 000.
3. Push the PLAY button and watch the tape counter. Press the STOP button at 010 (about 30 seconds).

4. Remove the Cleaning Cassette. Do not rewind the Cleaning Cassette at the end of each use. Rewind when the cleaning tape reaches its end and trips the automatic shut off switch.

The Cleaning Cassette may be rewound and reused several times. However, after prolonged use the Cassette will lose its effectiveness and will require replacement.

Do not use the Cleaning Cassette unless the picture symptoms (snow or streaks of snow, etc.) clearly indicate the need for video head cleaning. Excessive use of the Cleaning Cassette may shorten head life.

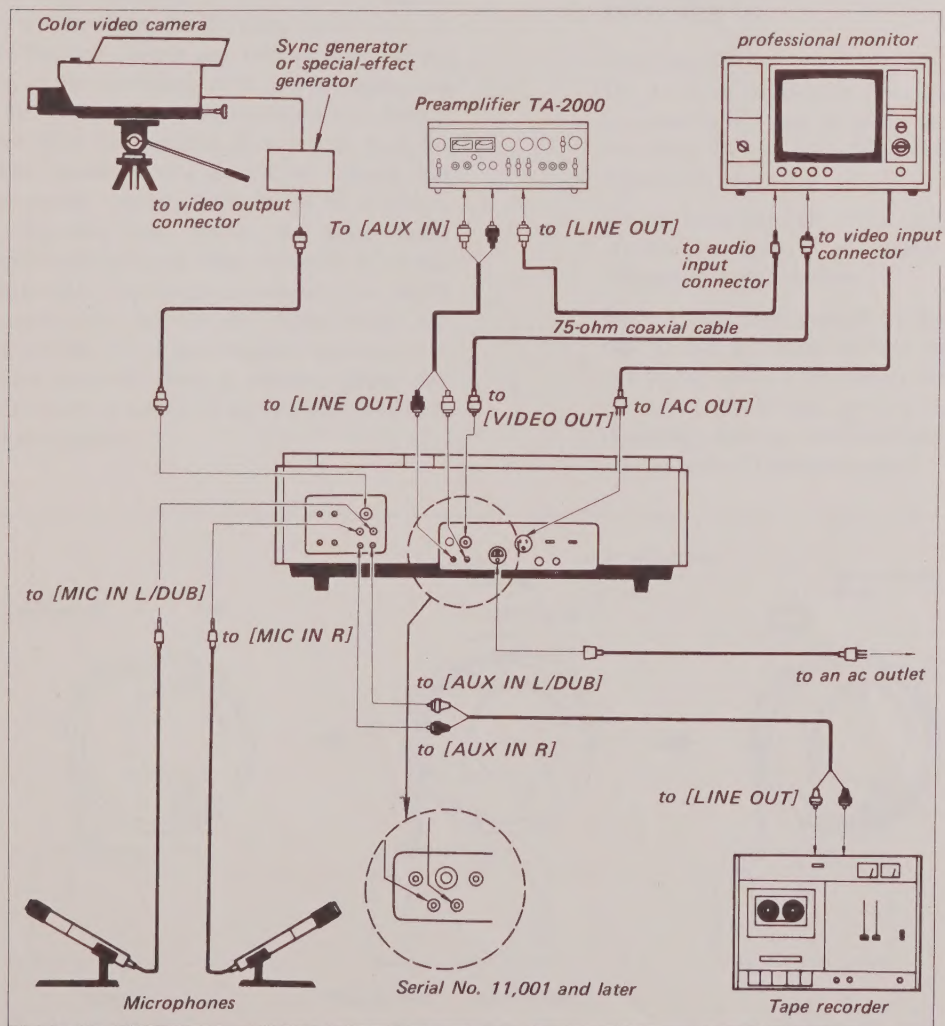


Fig. 1-5. Recordings from an external source

SECTION 2 TAPE TRANSPORT

2-1. GENERAL

The tape transport in the VO-1600 provides the mechanism for moving tape past the rotary and stationary heads at the correct speed of 93.5 mm per second (approximately 3-3/4 inches per second). In addition the transport mechanism performs threading and unthreading operations as well as fast forward and rewind operations. The latter are performed while the tape is inside the cassette.

The mechanical action of the tape threading system is shown simplified in Fig. 2-1. When the cassette drops into the operating position, the door of the cassette is opened and the threading roller is positioned in the triangular notch in the front edge of the cassette. This places the threading roller inside the tape span between supply and take-up hubs. At the beginning of the threading cycle the threading ring turns in the clockwise direction and the tape loop is withdrawn from the cassette as shown in *b* of the figure. The threading ring rotates in a plane that angles downward towards the front of the machine. As the threading ring rotates the pinch roller (mounted on the threading ring) comes up inside the loop. Thus, when threading is complete the pinch roller is positioned opposite the capstan inside the tape loop. At the end of the threading operation, the pinch roller pressure plate is pressed against the pinch roller shaft to squeeze tape between the pinch roller and the capstan.

Unthreading is accomplished by releasing the pinch roller and rotating the threading ring in a counterclockwise direction. During the unthreading cycle, the supply reel is braked and the tape loop is accumulated on the take-up reel.

Fast Forward and Rewind are accomplished while the tape remains inside the cassette. Driving torque is applied directly to the take-up or supply reel tables. Details of the mechanical system are as follows: For an explanation of system control, which electrically sets up the various modes of operation, refer to Section 3-4.

2-2. THREADING AND UNTHREADING SEQUENCE

1. Threading:

The brake is released on the supply reel table by solenoid A. Tape is pulled from the supply reel table by the threading roller. Refer to Figures 2-2 and 2-3.

2. During threading, to avoid tape slack, back tension is applied to supply reel table. (Threading back tension)

3. When a large tape pack is on the supply reel, tape is like to slacken around the head drum due to the inertia of the supply reel. To prevent the possibility of tape slack at the end of the threading cycle, an additional brake is pulled in momentarily. (Threading brake)

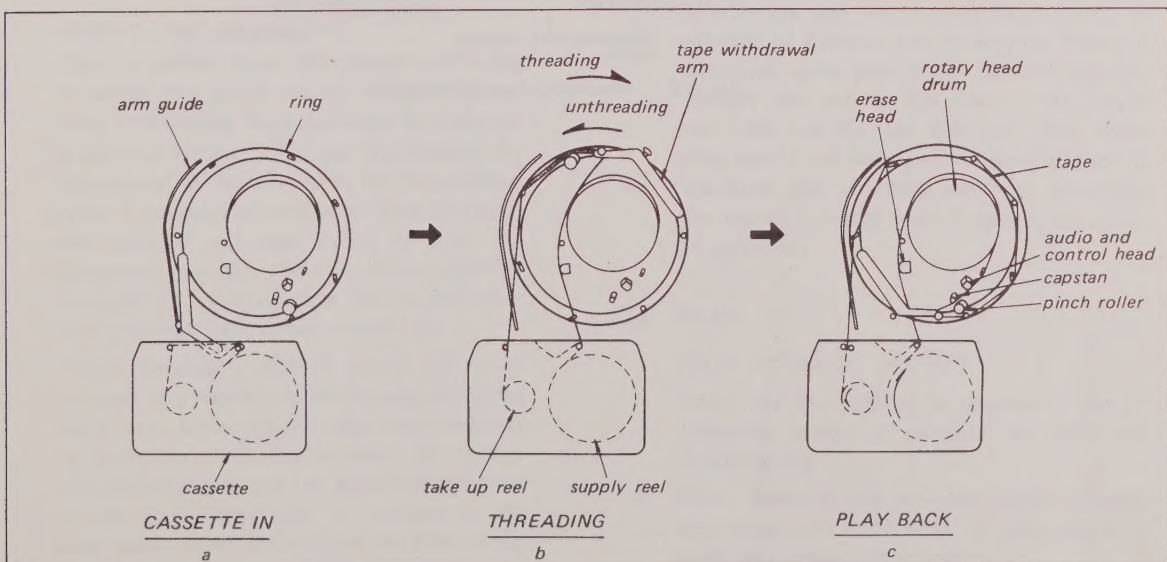


Fig. 2-1. Automatic tape threading mechanism

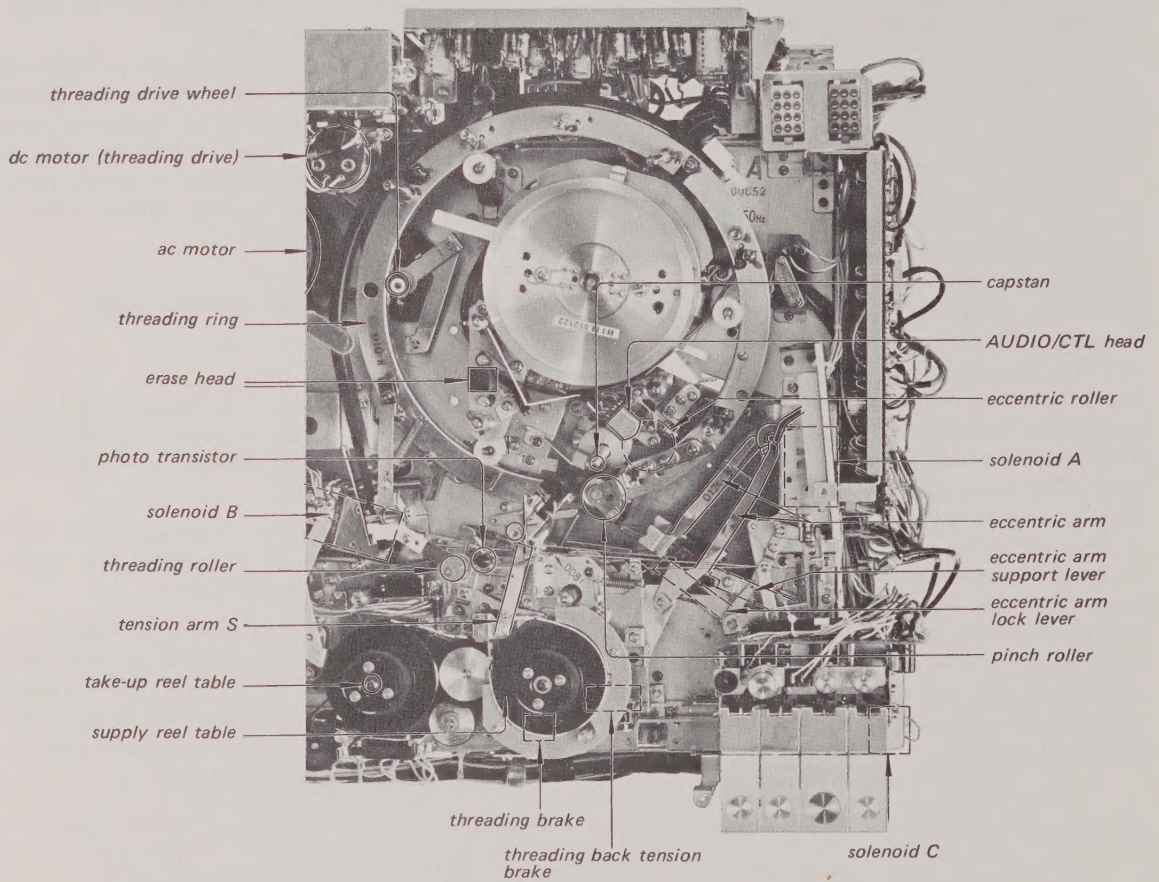


Fig. 2-2. Mechanical parts location

4. Even if the Threading Brake functions properly, there is still a possibility that tape slack will occur depending on the timing of threading brake engagement. When tape is driven by the capstan the tape tends to ride up and down on the guides at first due to excess slack in the tape. A small amount of tape slack is allowable as long as the tape stabilizes within three up and down movements after the pinch roller is engaged.
5. Unthreading:
The brake on the supply reel table is engaged. The tape is wound on the take-up reel as the unthreading mechanism returns.
6. There is a possibility that slack tape will be caught in adjacent parts if the threading mechanism returns faster than the take-up reel table can take up tape. The unthreading speed is adjusted so that tape slack will not occur at the lowest take-up speed. This should be at the very beginning of a tape. There would be no tape pack on the take-up reel table at this time.
7. If tape slack occurs during the unthread cycle at the end of a tape (tape pack on take-up reel is large), the take-up reel table rotation may not be smooth. If this occurs, make sure the tape cassette is seated properly on the cassette loading platform. Double check for proper operation after several rewind and fast forward operations.

2.3. AUTO-REWIND

(Refer to Figs. 2-2 and 2-4.)

1. Tape is pulled from the supply reel while threading and taken up on the take-up reel while unthreading. Thus, each time the machine is put into the stop mode, the tape advances by the amount of tape required for the unthread cycle. If the machine is then put back into play, that amount of tape would be lost. To compensate for this, the tape is automatically rewound for approximately one second after each unthread cycle. (Auto rewind (1))
2. If tape threading is initiated around the end of the tape, it is possible for the supply reel to run out of tape before the threading ring completes its cycle. To avoid this problem, the tape is automatically rewound for approximately four seconds each time "stop" is initiated by the clear leader, when the machine has been in the fast forward mode. (Auto-Rewind (2))

2.4. REWIND AND FAST FORWARD

(Refer to Figs. 2-2, 2-5 and 2-6.)

1. Rewind and Fast Forward are always accomplished in the cassette itself. The tape is not threaded around the head drum.
2. Rewind or Fast Forward is accomplished by pressing drive wheel located between the two reel tables against either the supply reel table or take-up reel table.
3. Rewind is accomplished by solenoid B simultaneously pressing the drive wheel against supply reel table and releasing supply-reel brake.
4. Fast Forward is accomplished by depressing Fast Forward button. This action presses the drive wheel against take-up reel table while simultaneously solenoid A releases supply reel brake.
5. Both ends of the tape have clear leaders attached. This clear leader will initiate automatic stop in all modes, returning the machine to stop and releasing the function buttons.
6. For a sixty minute cassette, Rewind or Fast Forward should take two and one-half to three minutes. If it is found that Rewind or Fast Forward time takes longer than three minutes, the fault may be due to the reels in the cassette not turning smoothly. Make sure the tape cassette is seated properly on the cassette platform.
7. If after the tape has stopped automatically at the end of Rewind, and the Rewind button is depressed again, Auto Stop will not function. All the tape will be rewound on the supply reel table and the tape will stall. This operation should not damage the cassette; however, the drive idler will wear severely. Therefore, the machine should never be left in this mode of operation.

2.5. PLAY

(Refer to Figs. 2-2 and 2-3.)

1. When the Play button is depressed, the dc threading motor is powered to drive the threading ring.
2. When threading ring completes approximately two thirds of its rotation, a microswitch is made that powers the ac motor.

3. At the end of the thread cycle, a microswitch is opened and the dc motor is disabled. This completes the threading cycle. At the same time, the eccentric-roller lock lever is released, and the pinch roller is moved toward the capstan by the eccentric-roller located underneath the capstan mounting plate.
4. As soon as the pinch roller presses against the capstan, the pinch roller is locked in position by the lever linked with solenoid A. After the pinch roller is locked, the eccentric roller returns to a neutral position.
5. As the pinch roller presses against the capstan, the tension arms on both supply and take-up reels are actuated to maintain proper tape tension.
6. When the Stop button is depressed, solenoid "A" is released, and the lock lever which keeps pinch roller pressing against the capstan is released by spring tension. The eccentric roller is driven by the capstan shaft and returns the pinch roller to the "rest" position. At the same time, the dc motor reverses and drives the threading ring back to the unthread position. The ac motor is still powered, so the tape is taken up by the take-up reel.
7. After the unthread cycle is completed, tape is rewound automatically for approximately one second.
8. During the time of unthread and auto rewind, after the stop button is depressed, the "Standby Lamp" is lit, warning the operator not to press other function buttons until the standby light extinguishes.

2-6. FUNCTION BUTTONS

1. Each button (Play, Fast Forward, Rewind and Stop) is linked to a slide switch.
2. When buttons such as Play, Fast Forward and Rewind are depressed, solenoid A or solenoid B will be energized so that the supply reel brake is released and push buttons are locked by the plate which is engaged by the solenoid C.
3. When any button except Stop is depressed, the mechanism locks out all buttons except Stop.
4. Depressing the Stop button releases solenoid A or B and the lock will be released.
5. During the unthread cycle, the plate linked with the thread ring locks out Fast Forward and Rewind buttons.
6. A transparent leader is attached at both ends of the tape. The transparent leader activates a photo transistor to provide the automatic stop signal. Automatic stop releases solenoid A or B releasing the previously selected function button putting the unit in the Stop mode.
7. During auto-rewind, solenoid B activates the lock plate that locks out all buttons except Stop button.

2-7. RECORD FUNCTION BUTTONS

1. During the Play mode the Record and Audio Dub buttons are locked out mechanically.
2. Audio channel 1 can be put into the Record mode during playback by pushing the Safety and Audio Dub buttons in sequence. The Safety button locks the Audio Dub button.
3. Recordings are started by pushing the Record and Play buttons simultaneously.
4. When the Stop button is depressed, all record function buttons are released and locked out.

2-8. CASSETTE LOADING COMPARTMENT AND ITS LOCKING MECHANISM

1. The cassette loading compartment allows the cassette to be inserted horizontally, then drops into place by gravity.
2. When the cassette is inserted into the slot, the tape cover is unlocked. As the cassette drops, the front tape cover is pushed open and the tape threading roller is positioned inside the tape loop.
3. As soon as the cassette drops into place, a microswitch closes allowing the unit to operate.
4. After the tape cassette is lowered the cassette loading compartment can be raised in the Stop mode only. In all other modes of operation, the platform is locked in the down position. This includes Play, Fast Forward, Rewind, Threading, Unthreading, and Auto-Rewind.

2-9. SUMMARY OF MECHANICAL ACTION

Figures 2-3 through 2-6

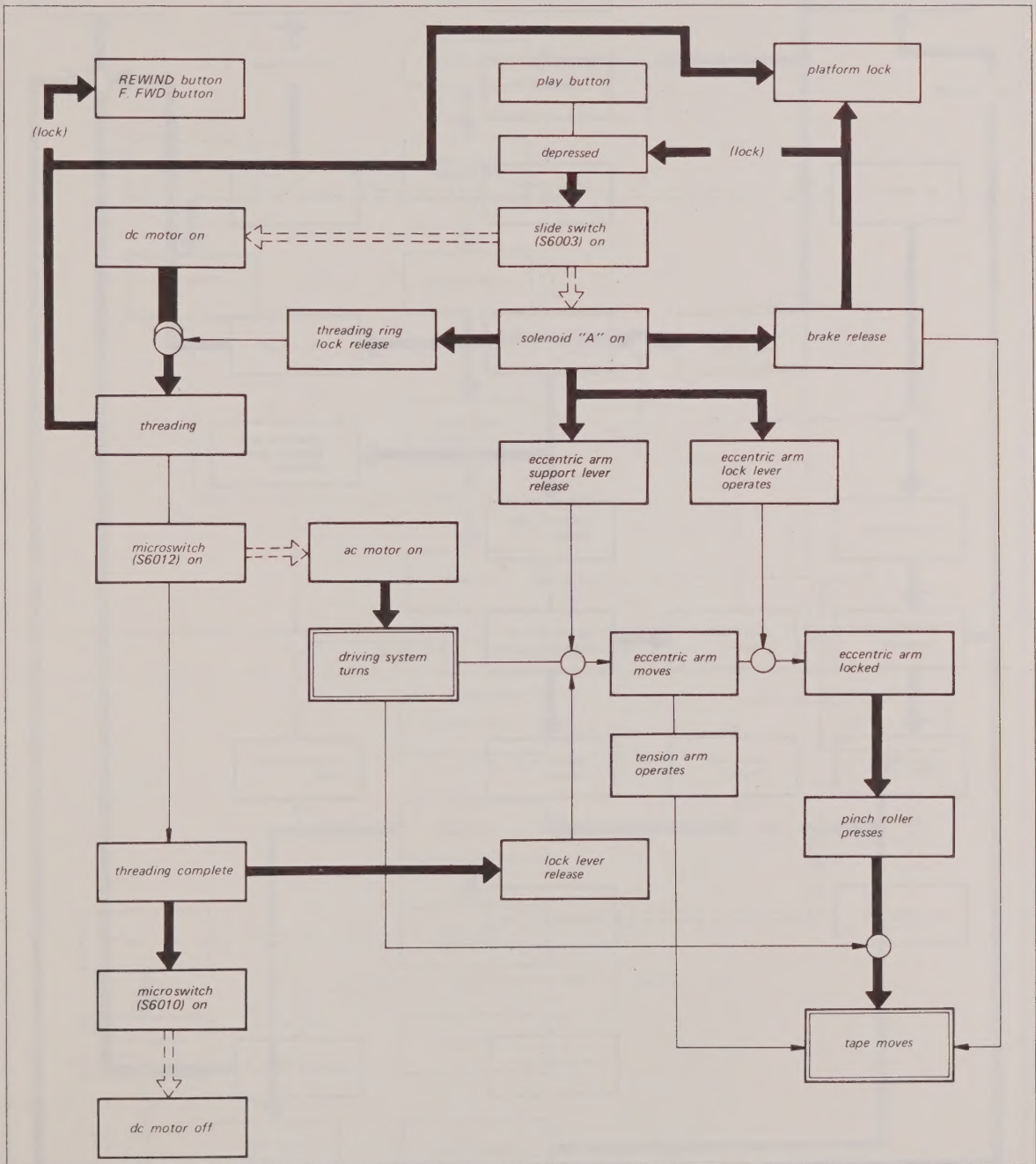


Fig. 2-3. Play mode sequence

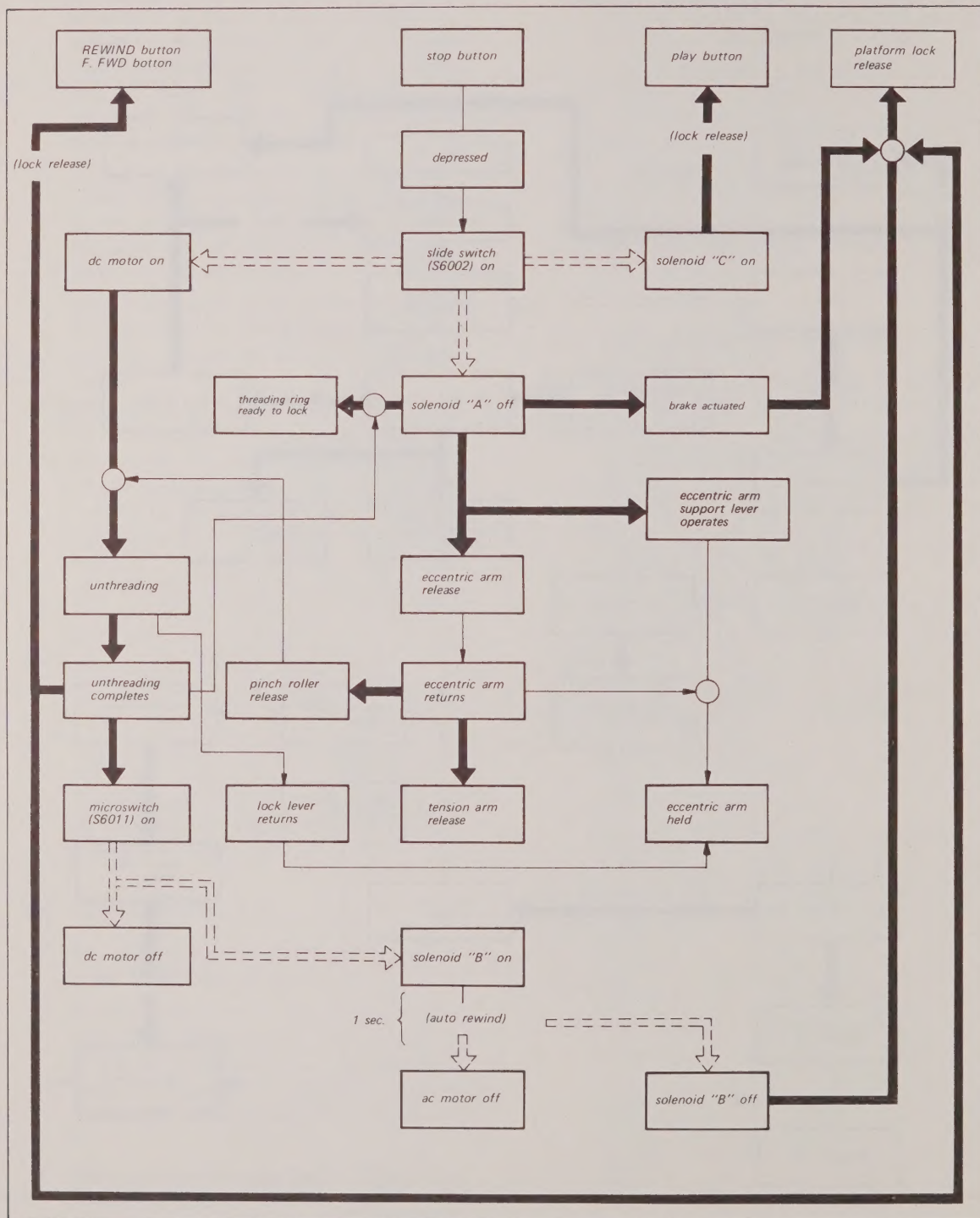


Fig. 2-4. Stop and auto rewind sequence

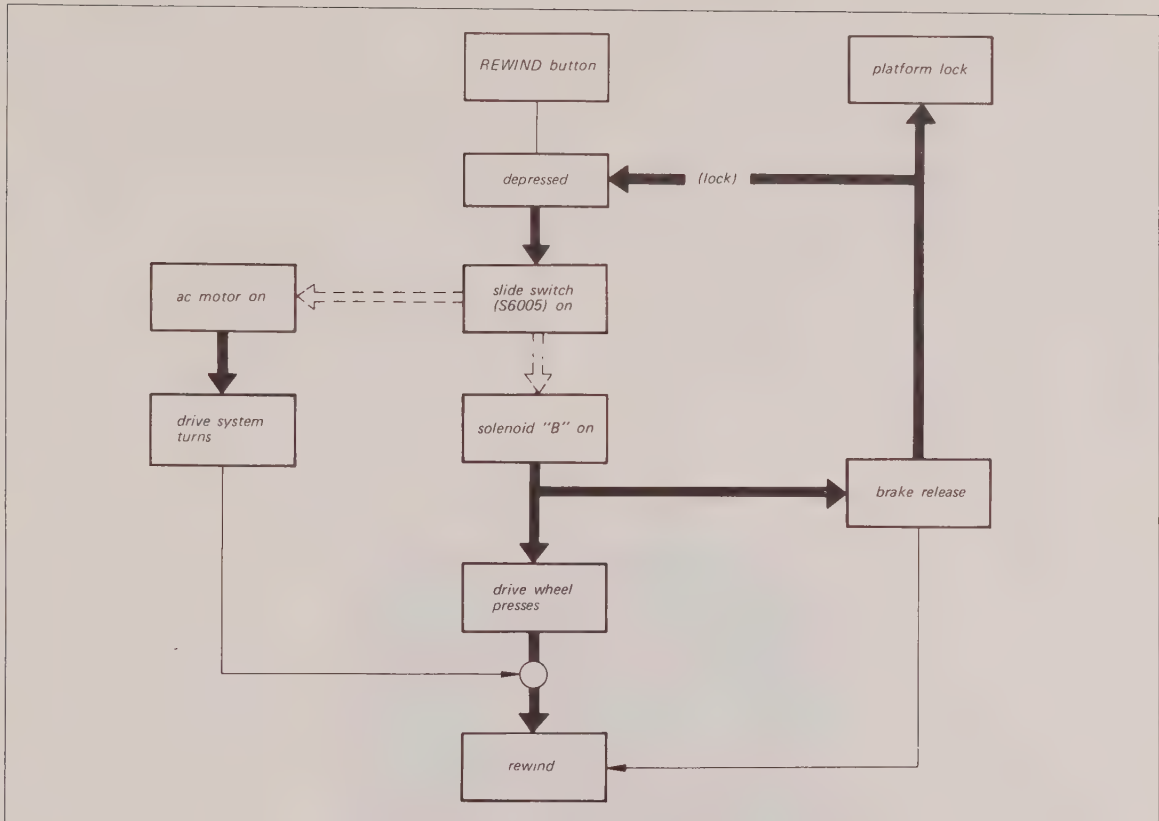


Fig. 2-5. Rewind sequence

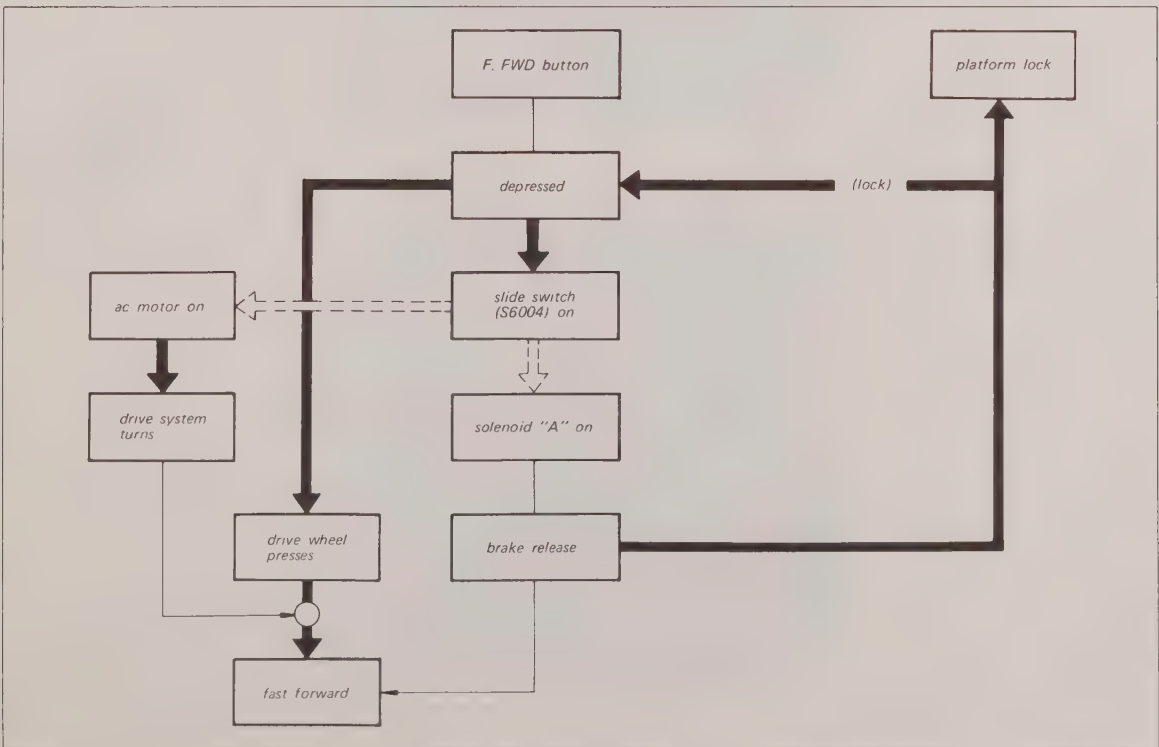


Fig. 2-6. Fast forward sequence

SECTION 3 CIRCUIT DESCRIPTION

3-1. GENERAL

Electronic circuitry in the VO-1600 is divided into seven major sections. These are video playback circuits, audio playback circuits, servo circuits, system control, VHF modulator, power supply and record pack.

Video processing during playback takes place in three printed circuit boards. Preamplification of video-head output as well as head switching and separation of r-f color and monochrome signals is accomplished in the B-R (R-F) board. The monochrome r-f signal is routed through the Dropout Compensator (K board) where dropouts are detected and r-f from the previous line is inserted to form

a continuous r-f envelope. See Fig. 3-1 for locations of the printed boards.

Color and monochrome r-f signals are then routed to the A-R board for final processing. Here the frequency modulated monochrome signal is detected and the 688 kHz chrominance signals are restored to sidebands of 3.58 MHz. These signals are added to produce the NTSC-type output signal delivered to the VIDEO OUT connector and the VHF modulator.

Audio signal processing for both L and R channels takes place in the C-R board. This board contains preamplifiers, equalizer circuitry and line amplifiers that supply the audio output jacks and buffers to supply signals to the VHF modulators.

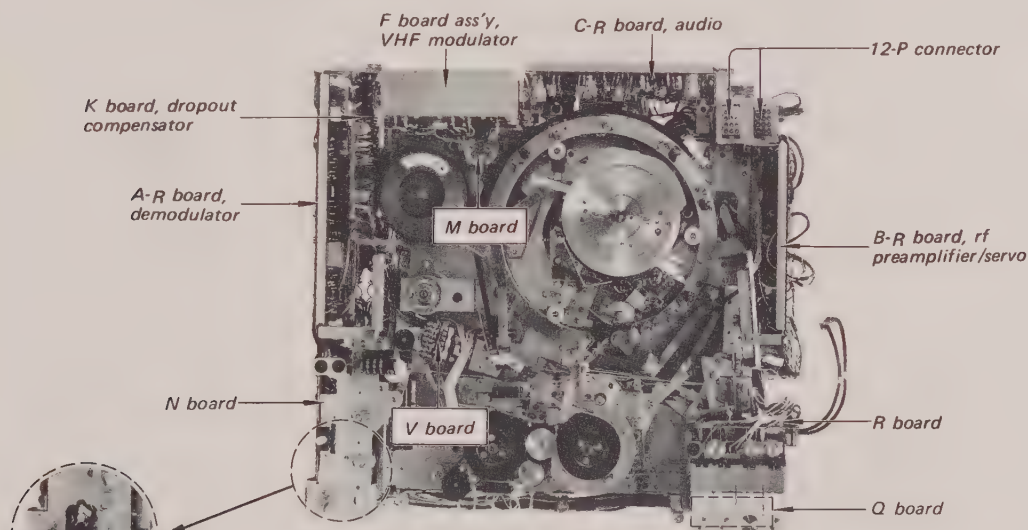


Fig. 3-1 (a).

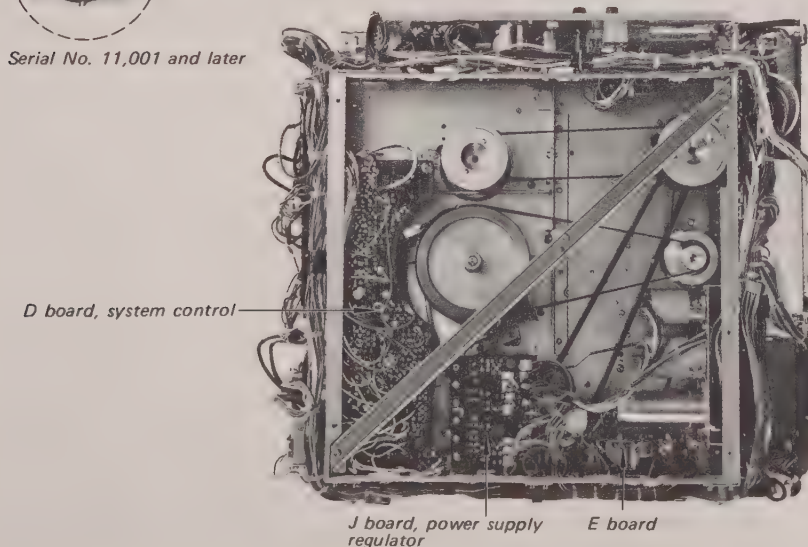


Fig. 3-1 (b).

Serial No. 11,001 and later

Microphone or AUX input signals are amplified for recording purposes in the H board. TV audio from the tuner is routed to channel 1 (R). In the sound-dub mode, audio from channel 1 (L) connectors is routed to the preamp. A separate E printed board houses the bias oscillator.

The servo circuits are on the B-R board. Both servo and r-f sections are mounted on the same B-R printed board. In the servo section playback control-track pulses are compared with pulses generated in the Rotary Head-Drum Assembly to control speed and positioning of the rotating video heads. In addition, 30 Hz pulses generated in the Rotary Head-Drum Assembly are used in the B-R board to establish the head-switching signal.

System Control, whose circuits are mounted on the D Board, controls tape threading and unthreading operations. It accepts manual commands to initiate Forward, Fast Forward, Stop, and Rewind modes of operation as well as automatic stop commands at either end of the tape. In addition, System Control regulates short duration automatic rewind operation to ensure resumption of play at the point of the tape where the Stop command was given and at the end of the tape to provide sufficient tape slack for threading operations.

The VHF modulator circuits are on the F Board which is fully enclosed in a shield box. This modulator accepts video and audio (L, R or mixed L + R) to amplitude modulate the video carrier and frequency modulate the audio carrier of channel 3 or 4. Channel selection is made at the rear-panel switch and control is achieved by switching tuned circuits by means of a polarity sensitive system using switching diodes.

The record pack combines a VHF/UHF tuner with the G, S and V boards that process input composite video prior to recording. The record pack can be separated from the main chassis mechanically. Electrical connections are made through multi-pin connectors. Signal processing consists of an AGC system, a precision FM modulator for the luminance signal, a color signal processor and the power amplifier to drive the video heads.

The power supply control circuits are mounted on the J Board with two series regulators mounted on heat sinks on the main frame. Separate regulators supply +12, +13, and +24 volts.

3-2. VIDEO PLAYBACK CIRCUITS

Video is recorded on the tape in the form of separate luminance (Y) and chrominance signals. The Y signal is frequency modulated using 3.8 MHz for the sync tip and 5.4 MHz for peak-white frequency.

Chrominance signals consist of direct recording of color sideband signals that have been relocated to a carrier frequency (carrier suppressed) at 688 kHz. See Fig. 3-2. The playback circuit of the VO-1600 must amplify the outputs of the video heads and equalize playback characteristics to provide a flat response throughout the r-f spectrum. Following preamplification the 688 kHz chrominance signals are separated from the high-frequency fm Y signals and these are processed separately to receive the luminance signal and restore the chrominance signals to sidebands of 3.58 MHz. The system of chrominance recovery is insensitive to phase variations that result from time-base instability. Details of the circuit are as follows: Refer to the schematic diagrams in Section 11 as well as the block diagram in this section.

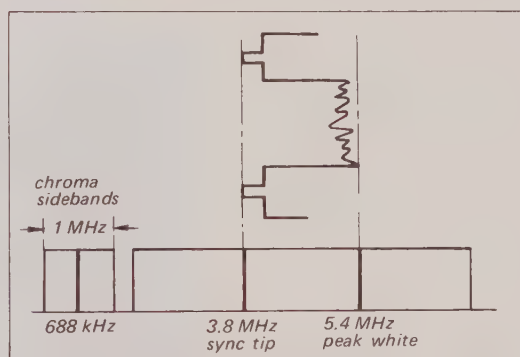


Fig. 3-2. Frequency range of rf signal

3-2-1. RF Preamp (B-R Board)

Video Heads A and B The video heads are in contact with the tape in excess of 180° of rotation of the head-drum assembly both in the original recording and in playback. Thus the time duration of each swipe exceeds one field and an overlap time of signal exists while both heads are in contact with the tape as shown in Fig. 3-3 (a). To prevent crosstalk between the two tracks and to eliminate loss of information, the signals produced by each head are switched as shown in Fig. 3-3 (b). The signals are then mixed to provide a continuous r-f signal. Head switching takes place 6.5 H ahead of vertical sync.

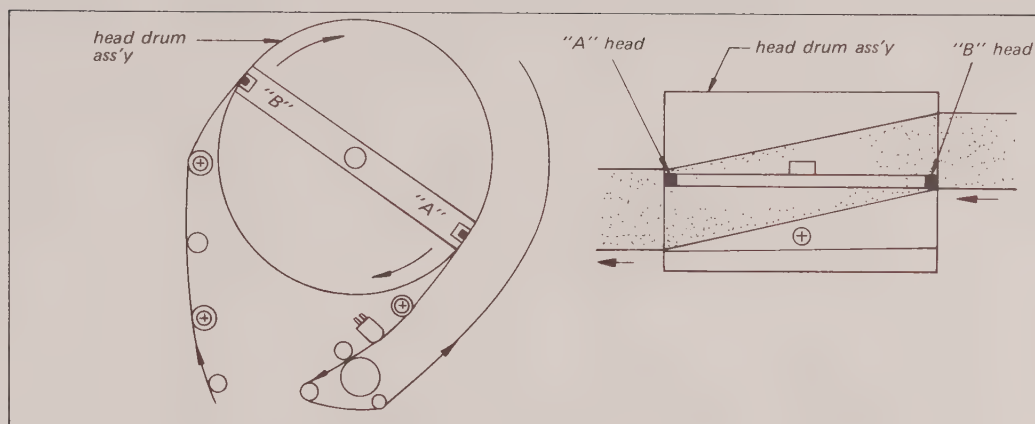


Fig. 3-3 (a). Overlapping condition

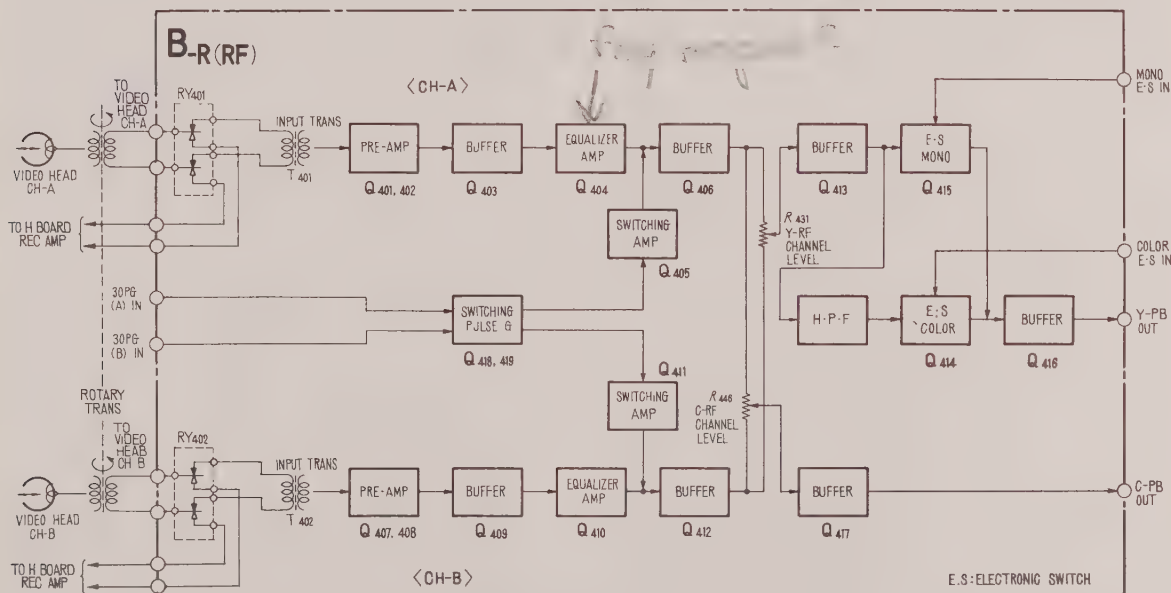


Fig. 3-3 (b). Block diagram of head switching

Signals from the video heads are coupled out of the drum assembly by means of rotary transformers. See Fig. 3-3 (b). These transformers have primaries that rotate with the top of the head-drum assembly and stationary secondaries. Coupling is accomplished by a ferrite enclosure with very small flux gaps.

Input Transformers
T401, T402

Signal outputs of the rotary transformers are routed

through the normally-closed contacts of the REC/PB relays RY401 and RY402. These relays are energized in the record mode to transfer the video head connections to the output of the record amplifiers (on the V board). In playback the r-f signal is applied to the primaries of

	matching transformers T401 and T402. The secondary circuits of these transformers tune the head inductance to the high end of the r-f passband.		
Preamps Q401, 402 Q407, 408	These components form a low-noise Cascode amplifier using an FET to drive the emitter of a common-base amplifier.	Buffer Q413	Q413 serves as the low impedance source of signal for two signal paths. One path of signal includes a high-pass filter. This path is used when a color recording is played back. The filter eliminates crosstalk between chrominance signals and lower-sideband fm signals. The remaining output of Q413 feeds directly to electronic switches via C419.
Buffers Q403, 409	Emitter followers buffer the coupling between the preamp and the equalizer amplifier. Signal level at the output of Q403, 409 (TP401, 403) is about 80 mV.		
Equalizer Amplifiers Q404, 410	Tuning and variable damping in the collector circuits permit adjustment of playback equalization. The signal path between the equalizer amplifiers and the output emitter followers contains the head switching transistors Q405 and Q411. These transistors are driven alternately into saturation to short the signal path to ground. The switching signal is a 30 Hz square wave developed by the bistable multivibrator Q418 and 419. Signals developed by two 30 PG coils mounted on the Rotary Head-Drum Assembly switch the multivibrator so that each playback channel is turned on during the time that the head is making its pass. The on interval begins 6.5 H before vertical sync and ends at the same time during the next field. Emitter followers Q406 and 412 isolate the switches from the balance controls and provide a low impedance source of signal for the parallel-connected balance controls.	Electronic Switches Q414, Q415	These transistors operate as series-connected SPDT switches with inputs at the collectors and a common output at the emitters. They select direct or filtered r-f for output to the demodulator section. The switches are actuated by bias applied to the bases of the switching transistors. Switching bias is determined by the presence of burst in the recorded signal as will be explained in detail later.
Switches Q405, 411		Buffer Q416	Buffer Q416 supplies Y r-f output signals to the limiters on the K Board. R445 determines input signal level which is set to about 200 mV (p-p).
		Buffer Q417	Buffer Q417 supplies chrominance r-f output signals to the A-R Board.
Buffers Q406, 412			
Balance Controls R431, R446	The Y (rf) and chrominance balance controls, R431 and R446 add and balance the output of the A and B am-		

3-2-2. Dropout Compensator (K Board)

The Dropout Compensator works in the Y r-f section. It develops a direct and a one-H delayed r-f signal. Should a dropout occur that is 26 dB below envelope peak level, a pulse is developed that is equal in time duration to the dropout. The pulse is used to switch in the delayed r-f signal. Thus, the r-f from the previous line is switched in to occupy the time interval during which the dropout occurs.

Limiters Q501, 502 D501-504	Input from the B-R board is first applied to two cascaded limiters. The diodes perform symmetrical limiting with Q501 and Q502 providing interstage amplification.	Buffer Q510	R-f signal output of Q 503 is fed through R542 to the output emitter follower Q510. This is the normal route for signal in the absence of dropout. Q510 feeds corrected signal to the A-R board for demodulation.
Buffer Q503	Emitter follower Q503 supplies limited r-f signals to the mixer balance control and the envelope detector.	1H Delay Line DL501	It also feeds signal into the 1H delay line for storage should a dropout occur on the following line. The delayed signal is amplified by Q509 and applied to an additional diode limiter. Limiter output is applied to the diode switch D508-D511. The diodes in this group are normally conducting, which returns the delayed r-f signal to ground via C524. During a dropout the pulse output of Q508 cuts off all diodes and the ground is lifted from the delayed signal path.
Envelope Detector Q504	The r-f output of Q503 drives Q504 which is biased for nonlinear operation to operate as an amplitude detector. Dropouts appear in the base circuit as serrations in the r-f envelope. They appear in the collector circuit of Q504 as positive pulses whose amplitude is proportional to the "depth" of the dropout.	Mix Balance R542	This control balances the direct feed against the delayed feed to provide an r-f envelope of uniform amplitude through the dropout interval.
Schmitt Trigger Q506, 507	Dropout signals developed by Q504 are applied to the input of a Schmitt trigger which acts as an amplitude sensor. Bias on this circuit is adjusted by R520 so that dropouts that are deeper than 26 dB from peak envelope level will switch on the Schmitt trigger. This yields a positive pulse of fixed amplitude at TP-503 each time a dropout larger than the threshold occurs. Pulse width is as wide as the dropout.	3-2-3. Signal Processing (A-R Board)	
V Blanking Gate Q505	The blanking gate shorts the envelope detector to ground for the duration of the 60 PG pulse to disable the circuit during the head-switching interval.	Demodulation of the fm signal, restoration of the chrominance signals to 3.58 MHz, Y and C mixing, and signal muting takes place on the A-R board.	
Pulse Shaper Q508	Positive pulses from the Schmitt trigger are amplified by Q508 to drive the Dropout Gate. This circuit provides switching pulses of equal amplitude and opposite polarities. (Positive at the emitter and negative at the collector).	Playback/E-to-E switches Q532, Q533	These transistors act as SPDT switches and select the signals to be demodulated. Note that Q533 is forced into conduction in playback mode only, delivering signals from K board, while in E-to-E or record mode, Q532 is turned on routing the Y recording signals from G board for monitoring use.
		Limiters IC501	R-f input from the K board is applied to IC501 which functions as a multi-unit differential limiter.

Carrier Balance R667	R667 is adjusted to balance the limiter to preserve waveform symmetry. It is adjusted for minimum carrier leak in the output video.	Electronic Switch Q539	ately generated. The signal path for monochrome operation is through Q539, a series-connected switch. The switch is on if there is no burst in the playback signal. The Y signal is fed through Q539, C616, C624, and R711 to the base of Q544. This emitter follower supplies video to the VHF Modulator via C628.
Detector Driver Q534	Q534 amplifies the output of the limiter to drive the fm detector circuit. The signal applied to the coupling transformer is differentiated by L510 to form spikes that correspond to the leading and trailing edges of the square-wave output of the limiters.	Buffer Q544	Q544 also supplies signal to Q545, another emitter follower that supplies signal to the VIDEO OUT (Monitor) connector. The diode clamp D531 in the base circuit of Q545 clips spikes from the most negative-going part of the signal to provide clean sync in the video output signal. The remaining path for signal supplied from the emitter of Q538 is through delay line DL502. This signal is mixed with 3.58 MHz chrominance signals across R701. Any residual 3.58 MHz signal in the Y signal is removed by trap L511 and C617 before the Y and C signals are added.
Fm Detector Q535, Q536	The fm detector functions as a full-wave rectifier/amplifier. It produces two negative pulses per cycle of input signal. In this way the detector doubles the carrier (ripple) frequency and puts it outside the passband of the low pass filter FL503.		
Low Pass Filter FL503	The low pass filter acts to integrate the detected pulses and provides an output proportional to pulse density. The maximum negative output occurs at the highest frequency. Thus peak white appears as the most negative-going signal.		
Carrier Balance R678	R678 balances the output of the detector for minimum carrier leak.	Y/C Mixer Q541	Mixed Y and C signals are amplified by the common-base amplifier Q541. Buffer Q542 supplies composite NTSC-type signal to the chrominance section of the electronic switch. If burst is present in the playback signal, Q540 is turned on and Q539 is off.
Y Level R681	R681 sets the level of detected Y signal that appears at the output terminal. It is adjusted for 1V (p-p) at the terminated VIDEO OUT (Monitor) connector.	Buffer Q542	
Video Amplifier Q537	Output of R681 is amplified by Q537 to the level required at the output terminals. C610, R687 and R685 provide de-emphasis.	Y Mix Level R708	R708 adjusts the level of Y signal in color operation to match that of the Y signal in monochrome operation.
Buffer Q538	Q538 serves as a buffer to provide a low-impedance source of signals to three signal paths. One feed is to a sync separator from which a burst-keying pulse is ultimately generated.		

3-2-4. Color Signal Processing

A simplified block diagram of color signal processing is shown in Fig. 3-4. Playback chrominance signals consist of sideband information grouped on both sides of a 688-kHz center frequency. These

signals are subject to frequency and phase errors introduced by minute time-base errors inherent in video tape recorders. The basic idea is to beat the 688-kHz sidebands against a 4.27-MHz source that has identical frequency and phase errors. The result is a constant difference-frequency centered about the NTSC subcarrier frequency of 3.58 MHz. The 4.27-MHz signal used in the frequency converter is developed in the lower line of blocks shown in Fig. 3-4. First the 688-kHz signal is converted to 4.27 MHz. This signal is then sent to a burst separator where a 4.27-MHz burst signal is extracted. Phase comparison between the final 4.27-MHz CW signal and 4.27-MHz burst (which contains the frequency and phase errors) takes place in the phase detector. This detector produces an error signal to control the phase of a voltage-controlled 688-kHz oscillator.

Response of this system is fast enough so that it can follow phase errors introduced in playback. The 688-kHz signal produced in the voltage controlled oscillator is converted up to 4.27 MHz by mixing the 688-kHz signal with a feed from the local 3.58-MHz oscillator. Details of color processing are as follows:

Playback/E-to-E
switches
Q511, Q512

These transistors act as SPDT switches and select the signals to be demodulated. Note that Q511 is forced into conduction in playback mode only, delivering signals from B-R board, while in E-to-E or record mode, Q512 is on, routing the chrominance recording signals from G board for monitoring use.

Low Pass Filter

688-kHz Color Level
R555

Color AGC
Q514

Burst detector
D512, D513

Input signals from the B-R (R-F) board are sent through a low-pass filter consisting of L503 and L504 and the capacitors C531 through C532 and C533. This filter separates 688-kHz chrominance signals from the frequency modulated Y signal. Frequency cut-off is 1.4 MHz.

R555 determines the signal output to the color processing system. It is set for 0.47V(p-p) at TP-506.

A fast acting color AGC system is used at this point to maintain a constant chrominance level despite differences in video head output. This is required to eliminate 30 Hz flutter in chrominance. Q514 is the gain control element. Its source-to-drain impedance forms a voltage divider with the series resistor R561. The impedance of Q514 is, in turn, controlled by a voltage doubler rectifier D512 and D513.

This circuit is driven from the burst gate and provides a positive output voltage proportional to burst amplitude.

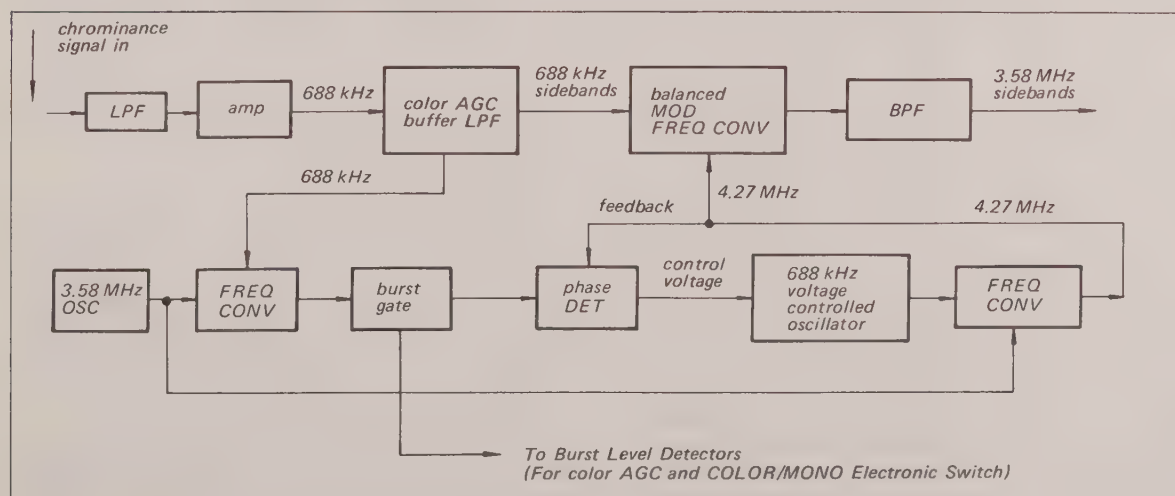


Fig. 3-4. Color playback system simplified

	A positive voltage at the gate of Q514 reduces the source-to-drain impedance and the output signal voltage developed at the junction of R561 and Q514. The color AGC system is disabled during the vertical blanking interval (no burst during this period) by a separated vertical sync pulse applied to the AGC detector output via R649.		
Color AGC Control R566	R566 sets the bias on Q514 and determines AGC range. It is set for 1.1V (p-p) at TP-508.	Subcarrier Oscillator Q519	A stable source of 3.58 MHz is provided by crystal oscillator Q519. The oscillator is free running and C553 is adjusted to provide correct subcarrier frequency.
Amplifier Q515	Amplifier Q515 follows the gain control element to restore signal amplitude to the value required in the frequency converter. A low-pass filter in the coupling circuit to Q516 cuts off at 1.5 MHz to eliminate crosstalk components above the chrominance range.	Frequency Adjust C553	
Buffer Q516	Emitter follower Q516 is a buffer for the low-pass filter and provides a low-impedance source of signal to two frequency converters. One converter is used to generate the 4.27-MHz signal from separated burst. The remaining converter, D514 through D517, beats the sidebands of 688 kHz against 4.27 MHz to provide sidebands centered at 3.58 MHz. The system for local generation of the 4.27-MHz signal will be described next.	Buffer Q520	Q520, an emitter follower, isolates the oscillator from the frequency converter.
		4.27 MHz Amplifier Q522	Output from the bandpass filter is amplified by Q522 to drive the burst gate Q523.
		Burst Gate Q523	Signals applied to the base of the burst gate are 4.27-MHz chrominance and a gating pulse generated from separated and delayed horizontal sync. An RC network in the emitter leg maintains a signal bias beyond cutoff so that the stage comes into conduction during the gate pulse interval only. The separated burst signal at the collector of Q523 is proportioned in amplitude to playback chrominance and contains the frequency and phase errors of the playback signal. The burst gate feeds three circuits: the phase detector and two level detectors. The first level detector (D512, D513) has been described previously in conjunction with the chroma AGC system. The second level detector (D527, D528) drives the mono/color mode switch.
Frequency Converter Q521	Q521 acts as a mixer. It is biased for nonlinear operation, has the 688-kHz signal applied to its base and a CW signal from the local 3.58-MHz oscillator applied to its emitter. A bandpass filter in the collector circuit of Q521 separates the sum frequency from the convertor	Phase Detector D518, D519	The phase detector compares a push-pull feed of separated burst at the secondary of T503 with a sample of the locally generated 4.27-MHz CW signal applied at TP-528. The result is a dc correction voltage whose magnitude is proportional to phase error. This error voltage is filtered by a low-pass filter C572, R615 and C573.

4.27 MHz Level Adjust R612	R612 sets the level of CW signal applied to the phase detector. It is set for an ac level of 2V (p-p) at TP-528.		
Detector Balance R726	R726 balances detector output for zero error when a correctly-phased chrominance signal is applied.		
Buffer Q546	Detector output is buffered by FET amplifier Q546 to isolate the detector from the low impedance of the forward-biased diode frequency-control component.		
Voltage Controlled Oscillator Q547	Q547 is a Colpitts type oscillator operating at 688 kHz. Frequency control is achieved by a voltage-variable impedance in series with C631, C632. This impedance is the forward resistance of D536 whose dc operating point is controlled by Q546.		D514 – D517.
Limiter D532 - D535	This limiter system in the gate circuit of Q546 limits the range of oscillator control to prevent excessive excursions during tape start up.	Frequency Converter D514 – D517	A feed from Q517 is also applied to the phase detector through C571 and R612 to provide the feedback signal for phase comparison. The frequency converter acts as a balanced modulator with 688-kHz chrominance signals applied from the centertap in T501 and ground. CW signal at 4.27 MHz is applied at the primary of T501. The balanced modulator transfers color sidebands centered at 688 kHz to sidebands centered at 3.58 MHz. The CW input at 4.27 MHz is suppressed by balanced operation. The bandpass filter FL501 passes the 3.58-MHz signals and rejects the remaining converter products.
Oscillator Bias R752	R752 sets the rest bias in the oscillator to obtain a signal frequency of 688 kHz.	Buffer Q518	Emitter follower Q518 provides drive for the chroma/Y mixer. Chrominance level in the output signal is determined by the setting of R581. Mixing of the Y and C components at Q541 takes place across R701. From this point to the output jacks the signal takes the paths that have been described previously.
Buffer Q548	Emitter follower Q548 isolates the 688-kHz oscillator from the mixer circuit that follows.	Chroma Level R581	
Frequency Converter Q549	Signal output from the 688-kHz oscillator is applied to the emitter of Q549 and a feed from the 3.58-MHz crystal oscillator is applied to the base. The sum frequency, 4.27 MHz, is tuned in the collector circuit and applied to the 4.27-MHz amplifier Q550. Filters in the collector circuit remove all mixer output components except the 4.27-MHz signal.	Sync Separator Q525 – Q527	Sync is separated from a sample of the video output signal to supply burst keying pulses to the burst gate and vertical blanking signals to the chroma AGC system. A sample of the video output signal is taken from the emitter of buffer Q538 and applied to the base of Q525 through a low-pass filter that removes high-order harmonics and video signals. The three stage separator provides composite negative-going sync at the collector of Q527. This signal is applied to a low-Q series resonant circuit consisting of R641, L509 and
Detector Driver Q517	CW signals at 4.27 MHz are amplified by Q517 to drive the frequency converter		

	C585. Horizontal sync pulses cause the tank circuit to ring for about 1-1/2 cycles and frequency is chosen so that the peak of the first half cycle coincides with burst timing. The signal so developed across C585 is applied to the burst gate as the gating pulse.	
Vertical Sync Separator Q528	A feed of separated sync from the collector of Q527 is applied to a two-section integrator R643/C587, R644/C588 to separate the vertical sync component. This signal is applied to the vertical sync separator Q528.	
Color/Monochrome V Sync Level R647	Emitter bias on this stage is set by R647 so that blanking pulses at the collector are of the correct level to maintain a constant AGC level through the vertical blanking interval.	
Color/Monochrome Electronic Switch D527, D528 Q529 – Q531	Burst is rectified by the voltage doubler D527, D528 to provide a positive dc voltage at TP-535 when burst is present in the playback signal. This sets the three stage direct-coupled switch as follows: Q529 ON, Q530 OFF, Q531 ON. The dc voltages that result at TP-519 (+16.5V) and TP-520 (+0.06V) set up color operation. In this case the Y fm signal is routed through a high pass filter in the B-R (R-F) board and the Y/C mixed output signal is selected by turning on Q540. If there is no burst signal in the playback signal the voltages at TP-519 and TP-520 reverse and the monochrome mode is selected. In this case the Y fm signal bandwidth is not restricted and video signal flow is through Q539.	chrome monitor is used for display purposes. The system works normally in the COLOR MONITOR position but monochrome operation is selected regardless of the type of signal played back if the switch is set to B/W MONITOR.
		Transistor Q543 shorts the base of Q544 to ground to eliminate video output signals during tape threading operations and during playback until control track pulses have been detected (indicating normal tape speed). The control voltage for Q543 is developed in D (system control) and B-R (servo) boards.
	Video Muting Q543	
3-3. SERVO CIRCUITS (B-R Board, Servo)		
	VO-1600 employs a braking-type servo to control video head-drum rotation (tape speed is fixed). In playback, when the track for field 1 of a pre-recorded frame comes into position for playback on the head-drum assembly, a control track pulse is read out at the control track head. This event is compared in time with a 30 PG pulse generated in the head-drum assembly that signals the position of the A video head. If the head is early, (head drum speed too high) the result of the pulse comparison increases braking current to retard head position. Late head arrival triggers the opposite effect. In the record mode, separated sync obtained from the input signal serves as the timing reference for the servo system. The servo employs two feedback loops, one of which integrates jitter in the playback control-track pulses.	
	In addition to servo control of the rotary head drum assembly, the servo system performs the following auxiliary functions; 30 PG pulses 180° apart for playback preamp switching, manual tracking control, blanking pulses for the drop-out compensator, detection of control track signals for video muting.	
	Details of the system are as follows:	
Monitor Select Switch S6014	CTL Amplifier Q1 – Q3	The control track preamp is set up as a nonlinear amplifier. Direct current feedback from the emitter of Q2 through D1 to ground main-

tains a bias on Q1 that is very close to cutoff. Thus negative CTL spikes have no effect upon the output Q1 but positive spikes drive the transistor into conduction (Signal level at this point is far too small for D1 to act as a rectifier. Q2 amplifies the negative pulses produced by Q1 to drive the final unbiased amplifier Q3 into conduction. Thus the signal produced at TP-2 is clean negative pulses at about 5.8V (p-p).

The CTL signal at TP-2 is applied directly to the monostable multivibrator IC2-C when the TRACKING control is off.

The CTL signal at TP-2 is also applied to a variable-delay system that delays the signal 1/30th of a second $\pm 8\text{m sec}$ to provide variable tracking. The tracking control switch selects either direct CTL feed or the output of the tracking-delay multivibrators.

Total delay is provided by two monostable multivibrators in cascade, IC1-B and C. Both MMV's are contained in the same integrated circuit. The first delay multivibrator is triggered by a negative CTL pulse coupled through D3. This cuts off the right hand transistor in the schematic and initiates the unstable state. The cut off interval for this transistor is determined by the time it takes for C12 to dump its charge through R17. This resistor is adjusted to provide part of the total delay. At the end of the unstable state a negative pulse from IC1-B triggers the third MMV IC1-C. This MMV functions in the same way except that the RC network that determines the duration of the unstable state is returned

Bias Source
Q5

Delay Adjust
R20

Ramp Multivibrator
IC2-C

Slope Adjustment
R37

Miller Integrator
Q7

Sampling Hold Gate
Q8

to a variable bias source at the emitter of Q5. The voltage at the emitter of Q5 is controlled by a voltage divider in the base circuit that includes the front-panel TRACKING control. R20 controls the range of the total time delay to provide an adjustable CTL pulse that straddles the correct time of arrival by approximately $\pm 8\text{m sec}$.

Fixed or variable-CTL pulses are applied to monostable multivibrator IC2-C. This Multivibrator generates a pulse to be formed into a sampling ramp in the next stage. The duration of the pulse is controlled by R37. Since this pulse will control the run down interval in the ramp generator, R37 acts to control the slope of the ramp. It is set for a slope of 0.5V per millisecond.

During record operations, vertical sync from the G board is applied through D7 to trigger the ramp generator.

During the active interval for Q7 that is initiated by the rectangular drive pulse, a negative-going ramp is generated. The amplitude of this ramp is sampled by the Sampling-Hold Gate Q8. This transistor acts as a switch that is turned on by a delayed 30 PG pulse that signals the start of the pass made by the "A" video head. During the 30 PG pulse interval, Q8 is effectively shorted from collector to emitter and C28 charges to the value of the ramp. At the end of the 30 PG pulse Q8 opens and C28 holds the charge until the next 30 PG pulse. Thus the voltage stored across C28 is determined by instantaneous head position. If the video head is early, the

Tracking Control
Multivibrators
IC-1B and C

Delay Adjust
R17

	ramp is sampled at a higher amplitude and the voltage across C28 increases. This in turn, will result in increased brake current. The system reaches equilibrium when the heads track precisely over the prerecorded tracks.		
Sampling Hold Pulse Amplifier Q9	Q9 amplifies the delayed 30 PG pulse to drive the Sampling Hold Gate.	Switching Position Adjustment R31	determined by the discharge time of C19 through R31 and R32. R31 is set for the condition noted above. The delayed pulse developed at TP-6 is fed out to the B-R (R-F) board to trigger the head switching multivibrator described earlier.
DC Amplifiers Q10 -12	Transistors Q10 and Q11 are connected in the Darlington configuration to prevent loading of the sampling-hold capacitor C28. Q12 acts as a power amplifier that supplies brake current. The brake, L6003, operates as a squirrel cage motor with a stationary field. An increase in dc coil current acts to brake the rotor that is secured to the shaft of the rotary head drum assembly.	30 PG Delay Multivibrator IC2-B	The second delay multivibrator IC2-B, injects a much longer delay and is set to place the 30 PG switching pulse at the correct position on the sampling ramp.
30 PG Coil A L6005	The feedback pulse that signals the pass of the A video head is generated by 30 PG Coil A. A direct current flows in the coil and when the iron vane fastened to the rotary head drum assembly sweeps past the coil, a sine-wave shaped signal is developed.	Lock Phase Adjustment R34	The delay injected by IC2-B is determined by the time taken for C21 to dump its charge through R35 and R34. The latter is adjusted to place the 30 PG pulse 450 μ sec after the start of the sampling ramp.
30 PG Pulse Amplifier Q6	The positive part of this waveshape drives Q6 into conduction generating negative pulses at the collector. The pulses so generated are delayed in the two cascade multivibrators that follow.		Note that R34 is not returned to +B but to a variable source of positive voltage found at the emitter of Q18. The voltage at this point is produced by a closed loop system that acts to integrate jitter in the playback control track pulses due to residual wow and flutter in the tape transport. The closed loop system functions as follows: A pulse feed from IC2-B is integrated by R70 and C42 and applied as a steep ramp to sampling-hold gate Q16. This gate is switched on by the control track pulse found at the input to IC2-C. Thus C43 charges and stores a dc signal proportional to control-track pulse jitter. Since C43 is quite large, the jitter component is integrated over a long time interval. The voltage so produced is buffered by Q18 to control the delay of the 30 PG pulse in IC2-B. In this way the 30 PG pulse is delayed to coincide with the average position
30 PG Delay Multivibrator IC2-A	The first 30 PG delay is very short and has little effect on the phasing of the system (i.e. the lead or lag of a video head with respect to the sampling ramp). The purpose of the short delay is to set the switching point precisely so that head switching from B to A heads, takes place 6.5 H ahead of vertical sync. The delay inserted by IC2-A is	Sampling-Hold Gate Q16	

of the control track pulses and the effects of rapid jitter are minimized. Diodes D12 and D13 establish correct operating points during tape start up.

30 PG Coil B L6006

The second 30 PG Coil (B) is mounted 180° from Coil A on the rotary head drum assembly. It generates a pulse as the B video head enters the tape path. This pulse is not utilized in the servo system but is used to trigger the head switching multivibrator and to generate the blanking pulse for the dropout compensator.

30 PG Pulse Amplifier Q4

Pulse amplifier Q4 amplifies the 30 PG (B) pulse to produce negative pulses. These are coupled to the Dropout Compensator (D.O.C.) multivibrator and delay multivibrator Q13, Q14.

30 PG (B) Delay Multivibrator IC1-A

This delay multivibrator operates in the same fashion as IC2-A. It generates the head switching pulse that achieves head switching from A to B. Its delayed output pulse is applied to the head-switching multivibrator in the B-R (R-F) board.

30 PG Delay Adjustment R14

R14 adjusts the delay of IC1-A so that head A to B switching occurs 180° from the B to A switch.

D.O.C. Multivibrator Q13, Q14

The D.O.C. Multivibrator generates a 60 Hz blanking pulse that disables the dropout compensator during the head-switching interval. Alternate switching from pulses supplied by both A and B 30 PG coils trigger the multivibrator at 60 Hz. Diodes D9 and D10 isolate the two 30 PG trigger circuit from one another.

PB Muting Q19 – Q21 D14 – D16

The muting system generates a positive voltage to mute both audio and video circuits

during threading and unthreading operations. In addition, video circuits are muted until tape comes up to speed and a correct picture can be displayed. The latter is accomplished by detecting the presence of playback control-track pulses. Audio is not muted by the CTL detector so that the operator may use the machine to playback audio recordings that are not accompanied by video. During threading and unthreading, a positive voltage is supplied from system control to pin 12 of the B-R board. This signal is coupled through D14 to turn on Q19. This effectively grounds the base of Q20 to cut off this transistor. Collector voltage at about +8 volts is supplied to the audio circuits, and through D15 to the video circuits. Muting extends past the cycling time for the tape threading mechanism by the time taken for C47 and C48 to discharge after removal of the voltage supplied by system control. R79 adjusts this time extension to ensure correctly synched pictures when muting is removed.

PB Muting Time R79

PB Muting, Video Q21

Q21 is cut off and the muting voltage at the collector is coupled through D16 to the video circuits. Diode D15 prevents the audio circuits from being muted from this source. When control track signals are received, signals at pin 11 of IC1-B turn on Q21 to remove the muting voltage.

3-4. RECORD VIDEO CIRCUITS (G and V board)

Recording circuits in the VO-1600 process the composite video signal to drive the video heads. Processing consists of first separating luminance and chrominance components. Thereafter the luminance signal is applied to a frequency modulator and the chrominance sidebands are shifted from a center frequency of 3.58 MHz to a new center frequency at 688 kHz. The fm video signals and the 688-kHz chrominance signals are added and applied to the rotating video heads. Linearity is preserved in the direct recording process used for the chrominance signals because the luminance fm signal acts as ac bias.

In addition to basic processing, the following auxiliary functions are performed; luminance and chrominance AGC, automatic switching of luminance bandwidth to suit monochrome or color input signals and sync separation. Separated sync is used to render the luminance AGC system insensitive to picture content, provide a delayed burst gate and supply a timing reference for the servo system during the record mode.

All video signal-processing circuits for record operations are mounted on the G Board. The output circuits that drive the video heads are mounted on the V Board.

Circuit details are as follows:

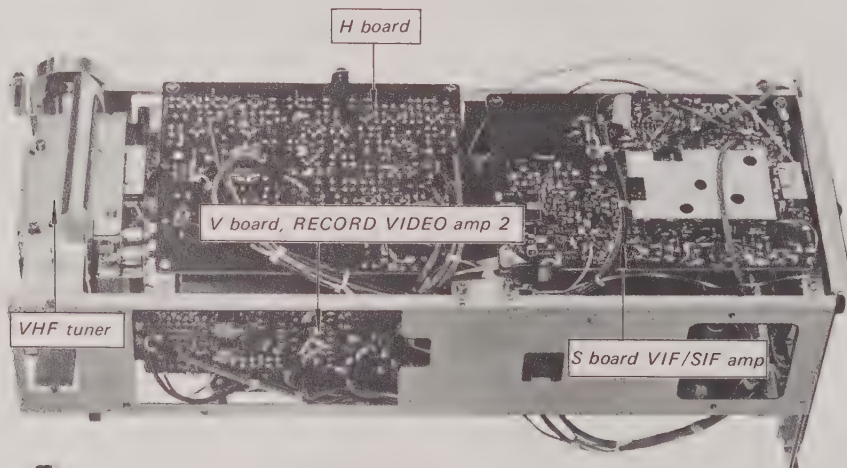


Fig. 3-5. Printed circuit board location (a)

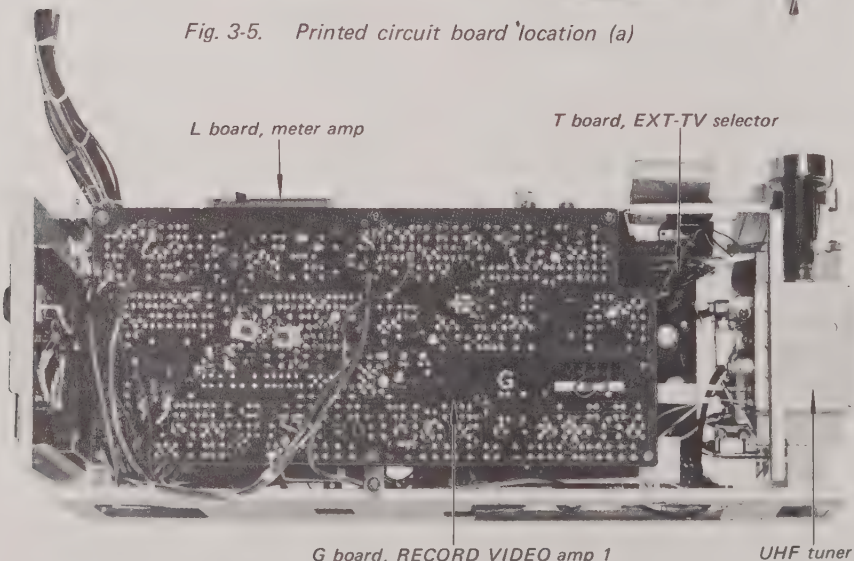


Fig. 3-5. Printed circuit board location (b)

S6201

The source of video to be recorded is selected by S6201. It selects the signal applied to the rear panel VIDEO IN receptacle or the output of S board.

Buffer
Q1 and Q2

Q1 reverses the polarity of the input signal from S board and slightly reduces its level to obtain standard video signal. The tank circuit L1 and C3 in the collector circuit of Q1 is tuned to the high end of the video bandpass to compensate for the slope of the i-f characteristic. Q2 serves as an emitter follower to supply a low-impedance source of video to the input selector. Signal from S6201 (measured at TP-1) is routed to the luminance processing circuitry, the chrominance processing circuitry and the sync separator system. The text follows those branches in the order given.

AGC Control
Q9

Luminance signal is applied first to an AGC control stage Q9, to provide a constant input level to the modulator regardless of variations in input signal level. AGC control is accomplished by voltage divider action using the series resistance of R33 and the output impedance of FET Q9.

AGC Level
R36

R36 sets the bias on Q9 to determine correct fm modulator input when a standard video signal is applied to TP-1.

Video Amplifiers
Q10, Q11

Amplification provided by amplifiers Q10 and Q11

correct for the attenuation resulting from the AGC stage. Degenerative feedback from the collector of Q11 to the emitter of Q10 maintains bandwidth. Output of Q11 is fed to the luminance AGC detector (Q12, D2, D3) and the mono/color switch (Q15, Q16, Q55, Q17).

Luminance AGC
Q12, D2, D3

Amplifier Q12 drives the luminance AGC detector. This transistor employs local negative feedback in the emitter circuit provided by L3 and C26. This tank circuit reduces gain at 3.58 MHz to render the circuit insensitive to color burst in back porch of sync. Q12 also mixes luminance signal with a narrow negative pulse applied at the emitter. This pulse is delayed to occur during the back porch of sync. It appears in the collector as a negative pulse that is always slightly more negative than peak white as shown in Fig. 3-6. Since peak white is fixed by the reference pulse, the total

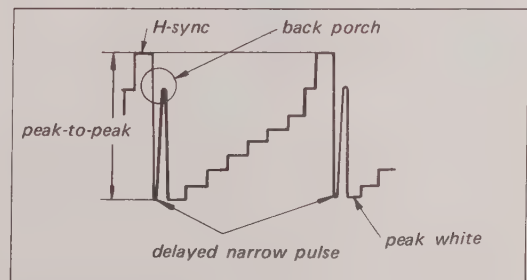


Fig. 3-6. Waveform at TP-4
(delayed pulse at back porch of sync)

peak-to-peak signal applied to the rectifier circuit is determined primarily by the amplitude of sync in the composite input. This renders AGC relatively insensitive to variations in picture content.

Diodes D2 and D3 function as a voltage doubler to provide a d-c control voltage proportional to sync amplitude. This positive-going voltage is applied to the gate of Q9. An increase in bias, resulting from a high input signal acts to reduce the source-to-drain resistance of Q9 to lower the output of the voltage divider.

Color/Mono Switch
Q13, Q14, Q15, Q17
Q16, Q55

Signal output of Q11 at TP-3 branches in two directions for color/mono selection. The route for mono luminance signal is via Q17. Luminance components of color input signals are applied to emitter follower Q13 (to drive the 3.58 MHz traps and the delay line DL-1). The traps remove chrominance signals and the delay line matches luminance time delay to the normal delay of the chrominance-processing circuits.

Color Mode
Luminance Level
R52

R52 adjusts the level of the filtered and delayed signal to match that of monochrome operation. The delay line terminates in the low input impedance of Q14 which is connected as a common-base amplifier. Output of Q14 is applied to the collector of color mode switch Q15. In the color mode of operation Q15 is saturated by bias applied at its base. This effectively shorts emitter to collector to transfer signal to Q16. If the signal to be recorded is monochrome, the absence of burst is detected (as will be explained later)

Amplifier Buffer
Q18, Q19

and forward bias is then removed from Q15 and Q17 is turned on to transfer the wideband signal to Q55. Q16 and Q55 share a common emitter resistor so that output of either the mono or color switches is developed across R64.

Signal output of the Color/Mono switch is fed to amplifier Q18 through the pre-emphasis network C38 and R71. Bias for Q18 is controlled by the sync-tip AFC system.

Emitter follower Q19 provides a low impedance source of signal for Low-Pass Filter A. This filter limits the video passband to minimize spurious response caused by excessive sideband width.

White Peak Freq
R76

R76 adjusts the total peak-to-peak signal swing at TP-6. Since the sync tip is effectively clamped by the AFC system, the setting of R76 determines maximum upward deviation or the peak-white frequency. It is set for a frequency of 5.4 MHz at peak white.

Modulator Drive
Q20

Q20 applies video to the control input of the frequency modulator. A diode clipper (D4) in the collector circuit of Q20 conducts if the positive signal excursion (at peak white) exceeds the voltage set by R83.

White Clip
R83

This prevents positive excursions that could cause over deviation of the modulator. R83 is set to clip signals to limit the peak-white deviation value to 140% of normal value.

Frequency
Modulator
Q21, Q22

Q21 and Q22 form a voltage-controlled symmetrical astable multivibrator. It is set up to oscillate at 3.8 MHz under no-input-signal con-

Carrier
Balance
R89, R90

ditions. The circuit is balanced by R89 in the collector circuit and R90 in the base circuit. These resistors are set for waveform symmetry to facilitate attenuation of the carrier signal in the demodulation process. (The demodulator operates as a frequency doubler to place the carrier outside the video passband. If waveform symmetry is not sufficient, residual carrier (termed "carrier leak") appears inside the video passband. Diodes D6 and D7 limit base current to minimize saturation delays when the transistors switch from on to off.

Frequency control is achieved by supplying source of video to the bases. A positive-going signal (white excursion) raises the bias to bring the cut-off transistor into conduction sooner, thereby raising the frequency of operation.

Output of the multivibrator is transformer coupled by T1 to convert from push-pull to single-ended feed. Output of T1 is fed through C56 to the demodulator (A-R) board for E-to-E operation. The signal that goes this route is demodulated and processed for application to the video out jack and VHF modulator. This makes it possible to monitor the signal, after modulation and demodulation, while the recording is in progress. The remaining feed from T1 applies signal to a symmetrical limiter.

Limiter
Q23, D8, D9

Amplifier Q23 drives the limiter which consists of two parallel and oppositely-poled silicon diodes, D8 and D9. These diodes conduct to limit signals that exceed about 0.6 volt in either direction.

Emitter follower
Q24

Sync Tip AFC
Q26, Q25,
D10, D11

Output of the limiter is buffered by emitter follower Q24, which serves as the feed point for the modulator AFC system and the video-head drivers. One branch of signal from Q24 is fed to amplifier Q26, which drives a low-pass filter. This filter places 3.8 MHz on the slope of the upper skirt of the filter. Thus the signal applied to Q25 is a function of frequency. If the modulator tends to drift higher in frequency, the output of the filter drops. A drop in modulator frequency has the opposite effect. Filter output is applied to a class C amplifier, Q25, which produces an output for frequencies within the range of the filter (predominately the sync tip frequency of 3.8 MHz). This output is rectified by voltage doubler D10 and D11 to provide a dc control voltage that is applied as feedback to the base of Q18. This dc bias, which is direct coupled to the modulator, acts to offset and change in sync-tip frequency. The remaining feed from Q24 supplies fm luminance signals via a second color/mono switch to the video-head drive circuits as follows:

Color/Mono Switch
Q40, Q41, Q42

Signal is coupled through C91 to the collectors of Q40 and Q42. Q42 is turned on in the monochrome mode (if there is no burst in the input signal). In the color mode, Q42 is off and Q40 is on, routing the signal through a high pass filter to the collector of Q41. Hence the fm signal is band limited to prevent crosstalk with the color sidebands centered at 688 kHz. Output of Q41 or Q42 is taken across R176 and

Emitter Follower Q44	fed to emitter follower Q44. Transistor Q43 is connected between the base of Q44 and ground to short out signal when a muting voltage is applied to the base of Q43.	Emitter Follower Q29	Buffer Q29 terminates the bandpass filter in a high impedance to secure the required skirt response and provide a buffered feed point for the burst gate/balanced modulator that follow.
Muting Q43	Muting voltage is supplied during tape threading by the servo board. The emitter of Q44 serves as the feed point for the amplifiers (V board) that drive both video heads.	Balanced Modulator Q35, Q36, Q37	Signal from Q29 is fed through C81 to the base of Q36. This transistor provides single-ended input to the balanced modulator. A CW input from the 4.27 MHz oscillator is applied to the base of Q37 and the base of Q35 which is at r-f ground. In this arrangement the push-pull components from Q36 are cancelled at the center tapped output transformer but the 4.27 MHz signal and the modulator products do not. The lowpass filter consisting of L11, L12, and C85 through C87 select the difference modulator components at 688 kHz. Thus, the 688 kHz output signal is produced without a carrier in the same way that the carrier is suppressed in the composite signal.
V Board Record Current Adjust R184, R186	Potentiometers R184 and R186 permit adjustment of drive to A and B video heads respectively to permit optimum record current.		
Record Amplifiers Q45, Q46, Q47 Q51, Q52, Q53	Amplifiers Q45 and Q46 (Q51 and Q52) supply the necessary preamplification and Q47 (Q53) act as power amplifiers. Record- current frequency characteristics are set by R195 (R223) and R197 (R226). Output of the power amplifiers is coupled through T3 and T4 to the REC/PB relays on the B-R board prior to application to the A and B video heads.		
Color Processing	To follow the path for chrominance-signal processing, refer back to the composite input signal feed point at TP-1. Composite signals are routed first through a high-pass filter C67, R114 and C68 to remove luminance components below 3 MHz.	Color REC Level R162	Potentiometers at the output of the low-pass filter set up the level of 688 kHz chrominance signals applied to the video heads (R162) and the level of signal fed to the A-R board for E-to-E operation (R161).
		Color E-to-E Level R161	
Chrominance Amplifier/AGC Q27, Q28	Q27 provides amplification of the separated 3.58 MHz chrominance signals and also provides AGC. Gain control is achieved by Q28 which acts as a variable resistance in the emitter circuit of Q27. Signal output of Q27 is routed through a bandpass filter that rejects signals outside the chrominance pass-band (3.58 MHz $\pm$ 500 kHz).	688 kHz Amplifiers Q38, Q39	Output of the Color REC Level control R162 is amplified by Q38 and buffered by emitter follower Q39 to drive the power amplifier Q54. Q38 is driven into saturation during mono recordings by a bias applied through R163 from the color/mono switch (Q17).
		Color Rec Amplifier Q54 (V board)	The output of this transistor is coupled to A and B video

	heads through C108/R202 and C129/R231 respectively. Chrominance signals are applied in shunt with the luminance signals to the video heads.	
Buffer Amplifier Q50	The signal feed from R161 is buffered by emitter follower Q50 to drive the demodulator circuits on the A-R board for E-to-E display.	ACC Amplifier Q31
4.27 MHz Oscillator Q48 and Q49	CW signal to drive the balanced modulator is produced by the Colpitts-crystal oscillator Q48. Feedback is developed by the voltage divider C112 and C113 and applied to the emitter resistor R207. Transistor Q49 is normally conducting in the color-record mode. It is cut off if the input signal is not in color to disable the oscillator during monochrome recordings.	Color Killer Q32
ACC and Color/ Mono Switching	Burst is separated from the input chrominance signal (at 3.58 MHz) to drive the color ACC system and the color-mono electronic switch. Chrominance output of Q29 at TP-11 is coupled to the base of the burst gate Q30 via C73 and R130. The base of the PNP transistor is also driven with a negative pulse timed to coincide with burst which is derived from the sync separator stages. Q30 is normally cut off by signal bias developed in the emitter circuit and comes into conduction only during the burst intervals. Thus the collector circuit contains separated burst. The tuned load for Q30 (C75 and L10) develops the burst signal and applies it to the detector D12 and D13.	Color Killer Threshold R143
		Color/Mono Switch Q33, Q34
ACC Level R135	The ACC level control R135 determines the level at which D12 will conduct on positive	
		signal swings and so determines the charge on C76. During negative signal swings C76 dumps its charge and the peak negative signal charges C79 via D13. Hence the voltage applied to the gate of the ACC amplifier Q31 swings less positive with an increase in burst level. Output at the source of Q31 is applied back to the base of Q28 for ACC control. Another feed from Q31 drives the color killer detector Q32. This transistor has an adjustable bias applied to its emitter via R143 to establish the threshold bias. Q32 will turn off when detected burst level drops below the emitter bias level.
		Q32 is on in the absence of burst in the input signal. This turns Q33 on and turns Q34 off. (Note that these are PNP transistors.) The positive voltage developed at the collector of Q33 is applied to the mono section of electronic switches at Q17 and Q42. In addition, Q38 saturates to shut down the color-record current circuits. In the color mode, Q32 cuts off to turn off Q33 and turn on Q34. The positive voltage then developed across R148 is applied to the color sides of the electronic switches at Q15 and Q40. In addition the 4.27 MHz oscillator is turned on by the application of forward bias to Q49.
		Input video is processed to separate sync to provide:
		1. vertical sync for the servo reference.
		2. a delayed burst gate for the ACC and color/mono switching system.
		3. reference pulses for the luminance AGC system.
		Sync Separation

Sync Separator Drivers Q3, Q4

Input video at TP-1 is amplified and inverted by Q3 and applied through emitter follower Q4 to the base of sync separator Q5. Positive going pulses at the base of Q5 drive this transistor into conduction to provide separated negative-going sync at the collector. Horizontal sync pulses at the collector of Q5 shock the low-Q tank circuit of L2 and C8 into oscillation for about 1½ cycles. The negative-going first half cycle is developed across C8 and is applied to the burst gate (Q30) as the gating pulse.

A second output of Q5 feeds through a two stage integrator C9, C10 and R19, R20 to develop negative-going vertical sync at the base of Q6.

Sync Amplifiers Q6, Q7

Amplifiers Q6 and Q7 amplify separated vertical sync for use as the servo reference. A 23V (p-p) negative pulse is developed at TP-2. Part of this pulse, developed across R25, is fed to the servo board to lock the servo in the record mode. A third feed from the sync separator Q5 is fed to Q8 through the 39 pF capacitor C14. This capacitor differentiates horizontal sync pulses to provide a positive-going pulse at the trailing edge of sync. Q8 conducts for a very short interval following the trailing edge of sync to provide a negative reference pulse during the back porch interval. This pulse is fed to the luminance AGC system to provide a reference-white signal as explained earlier.

AGC Reference Pulse Amplifier Q8

3-5. SYSTEM CONTROL

Mechanical functions connected with tape threading and unthreading, the initiation and regulation of PLAY, STOP, REWIND, and FAST FORWARD modes as well as automatic stop action at the end of the tape are performed by the System Control circuitry.

There are nine distinct modes of operation performed by System Control. The system becomes operable after the power switch has been depressed and a VIDEOCASSETTE has been inserted into the holder. The operation modes are:

- 3-4-1 PLAY
- 3-4-2 Manual STOP, during PLAY mode
- 3-4-3 AUTO REWIND (1) at tape run-out during PLAY
- 3-4-4 REWIND
- 3-4-5 Manual STOP, during REWIND
- 3-4-6 AUTO REWIND (2) at tape run-out during PLAY or FAST FORWARD
- 3-4-7 FAST FORWARD
- 3-4-8 Manual STOP, during FAST FORWARD
- 3-4-9 AUTO STOP at tape run-out during FAST FORWARD

To aid in understanding and troubleshooting the system, separate functional diagrams will be shown

for each function. A brief summary of all mechanical and electrical actions will precede the functional diagrams. Refer to the functional diagram and the complete block diagram on pages 11-4 ~ 11-9.

System Control is disabled until power is applied and a VIDEOCASSETTE has been inserted. The latter is accomplished by S6009, the microswitch that is actuated when the loaded VIDEOCASSETTE holder falls into the operating position. Switch S6009 applies +13 volts to the System Control board.

3-5-1. Play Mode

The PLAY mode sets up tape threading, starts the head drum/capstan motor, locks out all operating buttons except STOP, puts the pinch roller in place, starts tape motion and activates the back tension regulator.

The VIDEOCASSETTE is also locked in place. The three distinct sequences to put the machine into the play mode are shown in Figs. 3-7 through 3-9. Sub-Function 1 – STOP INTERLOCK

During the final phase of tape threading, the STOP button must be disabled. Initiating STOP at this time would cause the mechanism to jam in the threaded condition. See Fig. 3-10 (a).

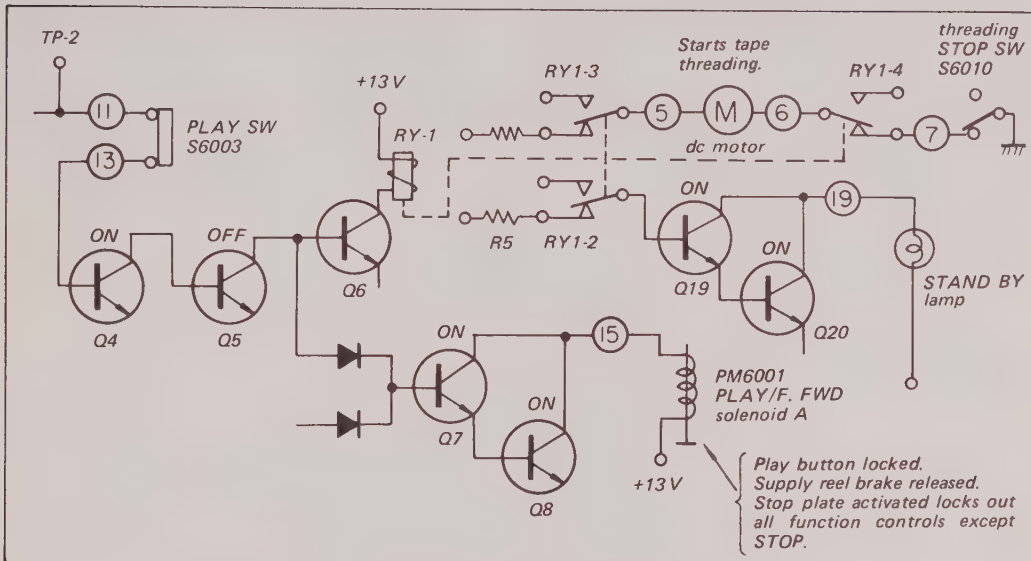


Fig. 3-7. Start tape threading

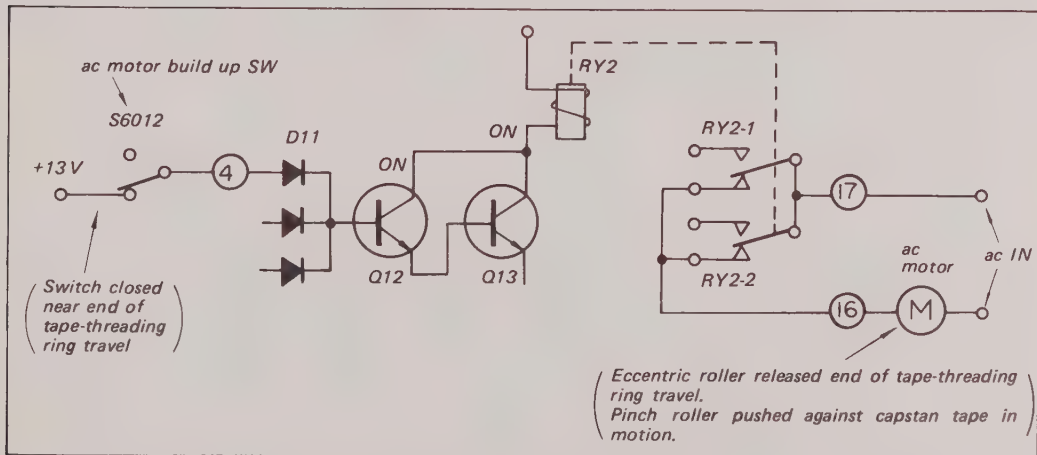


Fig. 3-8. Head-drum/capstan (ac) motor starts

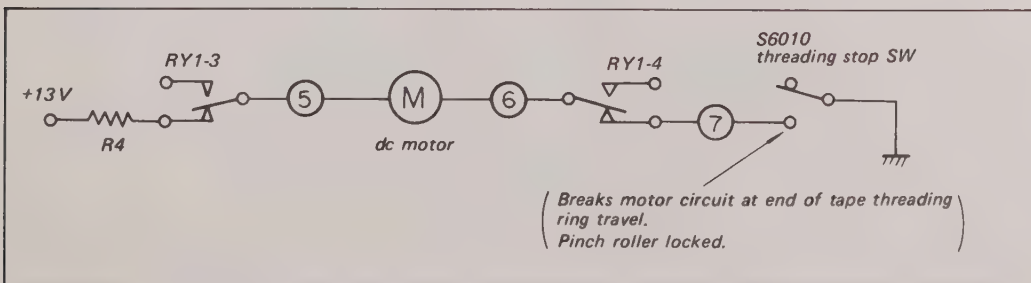


Fig. 3-9. Finish tape threading (1) (Stop function lockout)

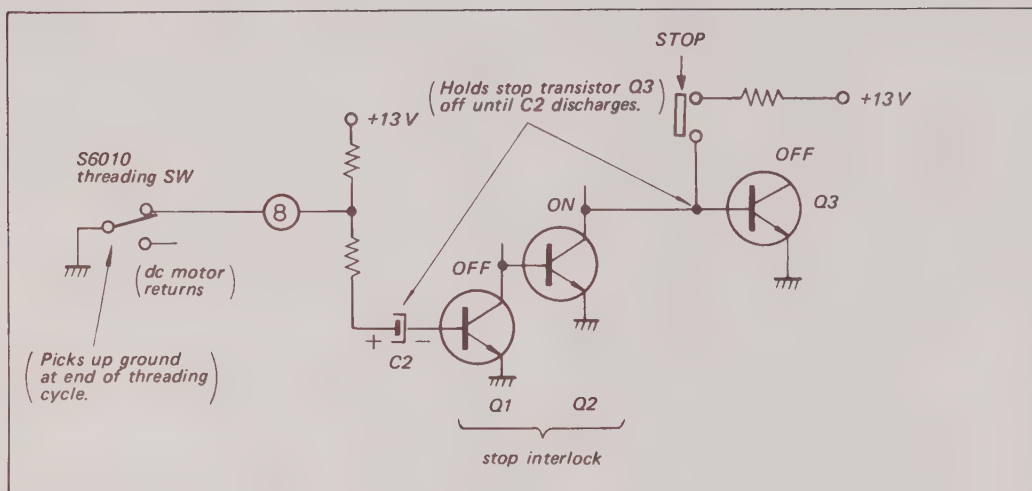


Fig. 3-10 (a). Finish tape threading (2)

Play Lockout

The circuit shown in Fig. 3-10 (b) prevents PLAY from being initiated during the unthread cycle. This prevents reversal of the threading ring in mid cycle and formation of a slack-tape loop. While the

threading ring is in mid cycle, both S6010 and S6011 are open as shown. Q4 is normally off. This keeps Q3 (Stop) saturated until unthreading is completed. In early units diodes D23-D25 are mounted on a separate small Y board.

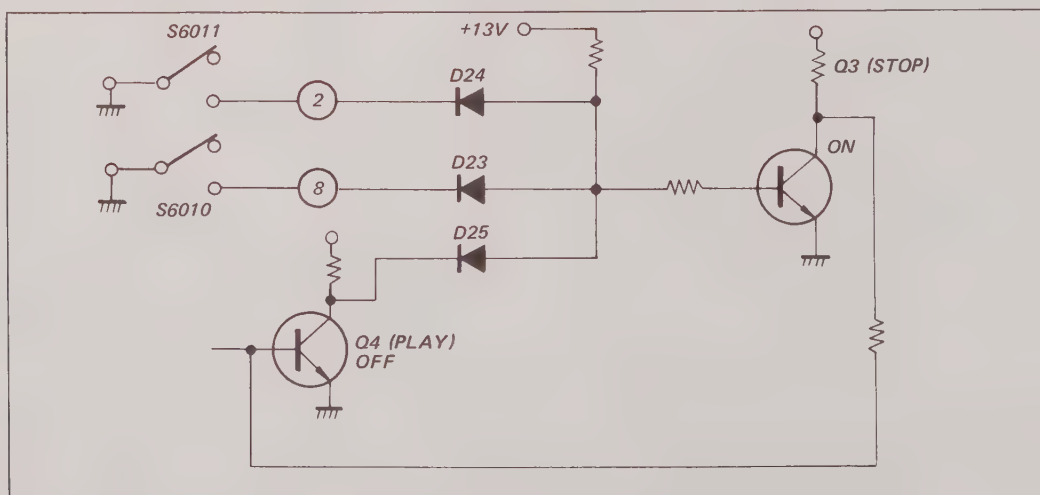


Fig. 3-10 (b). PLAY lockout during unthread

3-5-2. Manual STOP, During Play Mode

Conditions during PLAY mode, prior to pressing STOP button are as follows.

1. RY1 energized; see PLAY 1 (Fig. 3-7)
2. RY3 energized; see below

The sequence of events that follow the action of

the STOP button are shown in Figs. 3-11 to 3-15.

At the end of the unthreading cycle following manual STOP a short rewind interval, called Auto-rewind 1 is initiated. Tape rewinds for about one second. This repositions the tape to compensate for the threading loop and ensure restarting at the point where the tape was stopped.

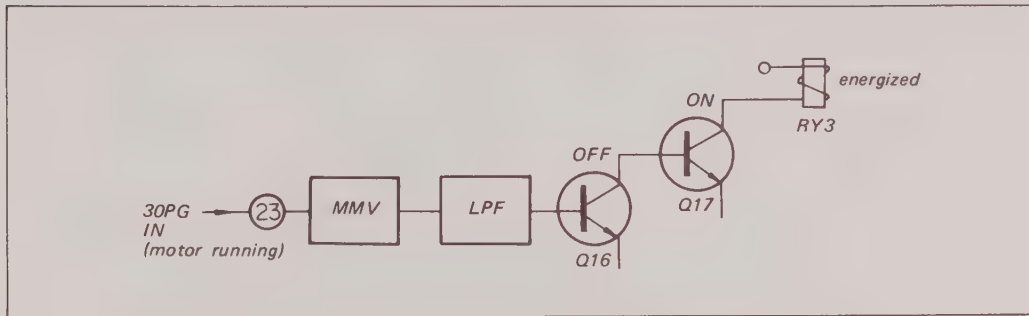


Fig. 3-11. RY3 energizing system

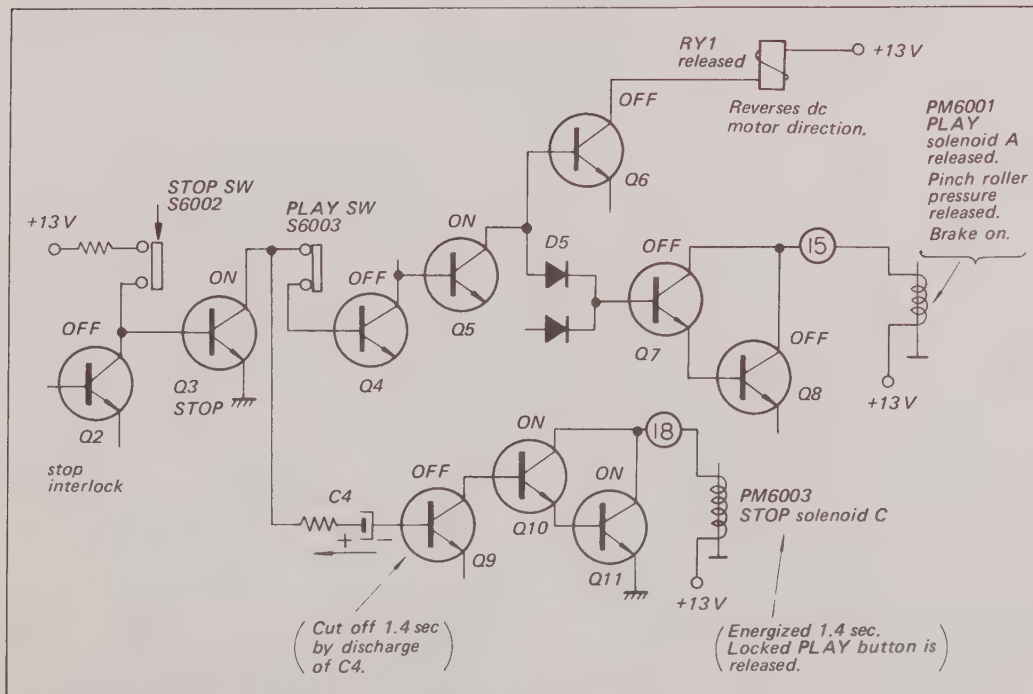


Fig. 3-12. Manual stop action during play mode

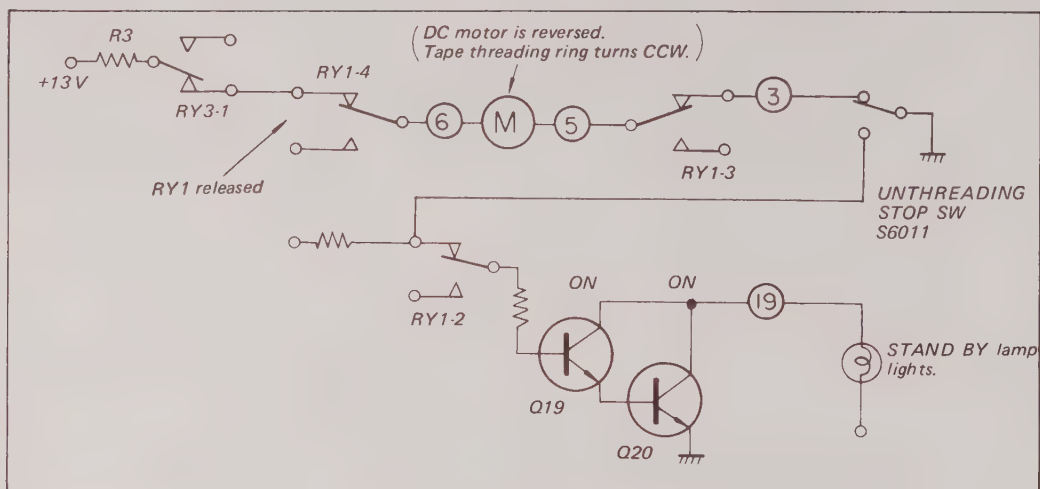


Fig. 3-13. Tape unthreading starts

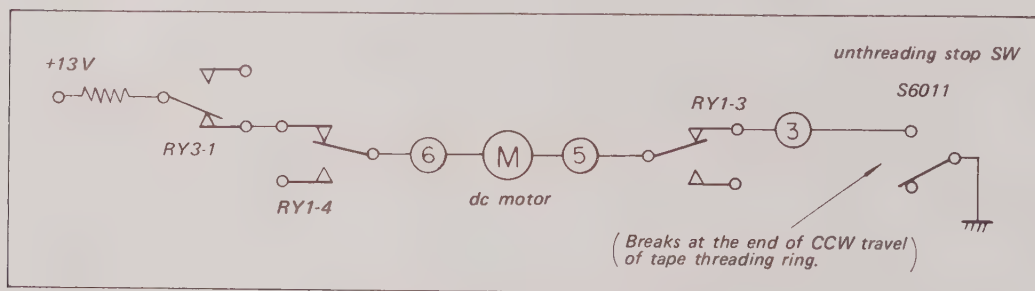


Fig. 3-14. Tape unthreading finished

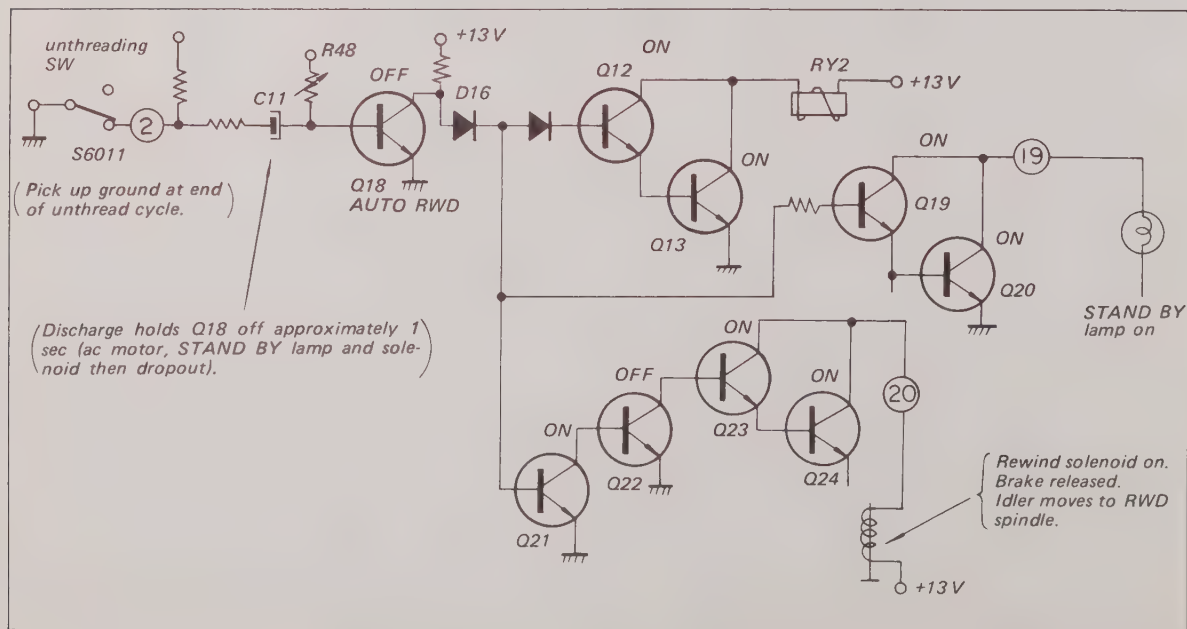


Fig. 3-15. Auto rewind action

3-5-4. Rewind

Rewind Solenoid B is energized. Main (ac) motor energized. REWIND button is latched. Take-up reel spindle is released. VIDEOCASSETTE is locked in place. Rewind solenoid is energized and supply reel spindle is driven in reverse. See Fig. 3-17.

3-5-5. *Manual Stop During Rewind

Rewind Solenoid B is released. Stop Solenoid C is energized momentarily to unlatch the REWIND

button. Main (ac) drive motor is switched off. See Fig. 3-18.

3-5-6. Auto Stop At Tape Run-Out During Rewind

End of tape is sensed by clear leader at beginning of tape. Auto Stop signal is generated. Rewind Solenoid B is released. Stop Solenoid C is energized momentarily to release REWIND push button. The Main (ac) Drive motor shuts down. Refer to Fig. 3-19.

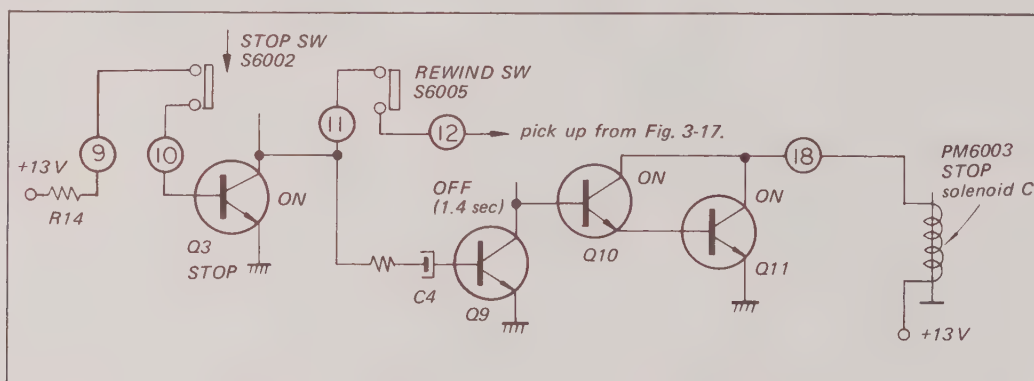


Fig. 3-18. Manual stop action during REWIND mode

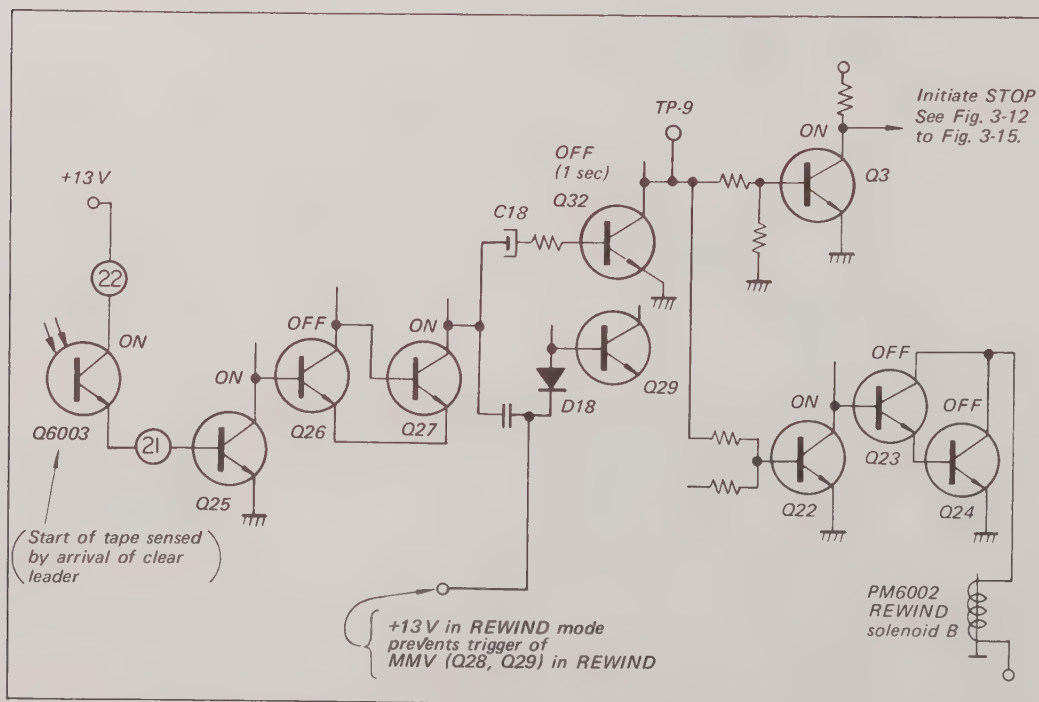


Fig. 3-19. Auto stop action during REWIND mode

3-5-7. Fast Forward

Play/Fast-Forward Solenoid A is energized to release Supply Reel brake. Drive idler is pressed against top drive surface of Take-Up Spindle Assembly to advance tape quickly. (Tape is not withdrawn from VIDEOCASSETTE). Fast Forward button is latched. VIDEOCASSETTE is locked in place. Stop plate is activated to prevent all buttons but STOP from being pushed. Main drive motor (ac) is switched on. Refer to Fig. 3-20.

3-5-8. Manual Stop During Fast Forward

Play/Fast-Forward Solenoid A is released. Stop Solenoid C is energized to unlatch F FWD button. Idler pressure is released (mechanical action only.) Main Drive Motor (ac) is switched off. See Fig. 3-21.

3-5-9. Auto Stop At Tape Run-Out During Fast Forward

Tape run-out is sensed by illumination of the phototransistor through the clear leader. This switches off the Play/Fast-Forward Solenoid A and activates the Stop Solenoid C momentarily. Re-

wind Solenoid B is then energized for 3 to 4 seconds to set up the AUTO REWIND 2 mode. At the completion of this interval the Rewind Solenoid B is released and the Main Drive Motor is de-energized. See Fig. 3-22 (b), (c), (d), (e).

After 4–5 seconds, MMV Q28 & Q29 returns to its stable state (Q28 off, Q29 on). At this time all transistors shown in Fig. 3-22 (a) reverse their states of conduction bringing Auto Rewind 2 to a stop.

Sub Function 2 – MMV and RY3 Protection Circuit

To prevent triggering of the ac Motor build-up relay RY3 and the AUTO STOP/RWD2 mode by the switching transient when power is first applied, the circuit shown in Fig. 3-23 is used.

Q30 on for approximately one second after power is first applied. This holds Q17 (and RY3) off and Q28 (MMV) off for the same period of time. Sub Function 3 – Automatic Threading Ring Return

System control has been set up to return the loading ring to the starting position should it leave the starting position due to vibration during shipment. Power supply voltage (+13V) is applied to the D board so that the machine will complete tape unthreading (See Fig. 3-14) to return the threading ring to the starting position. All that is necessary to reset the machine is to depress the power switch.

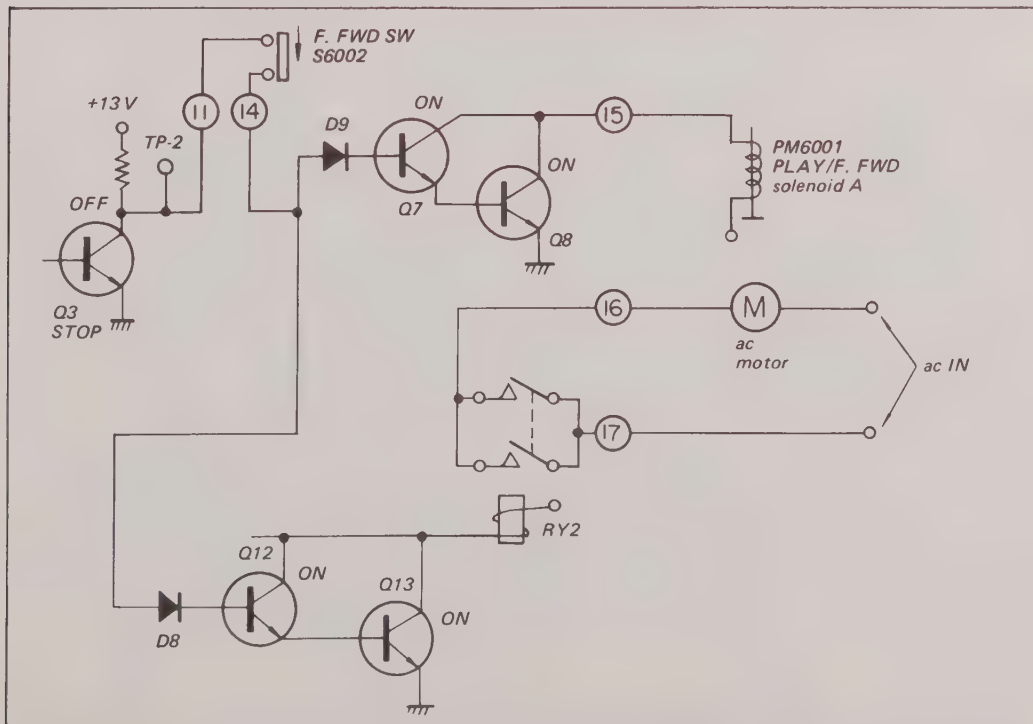


Fig. 3-20. Fast forward action

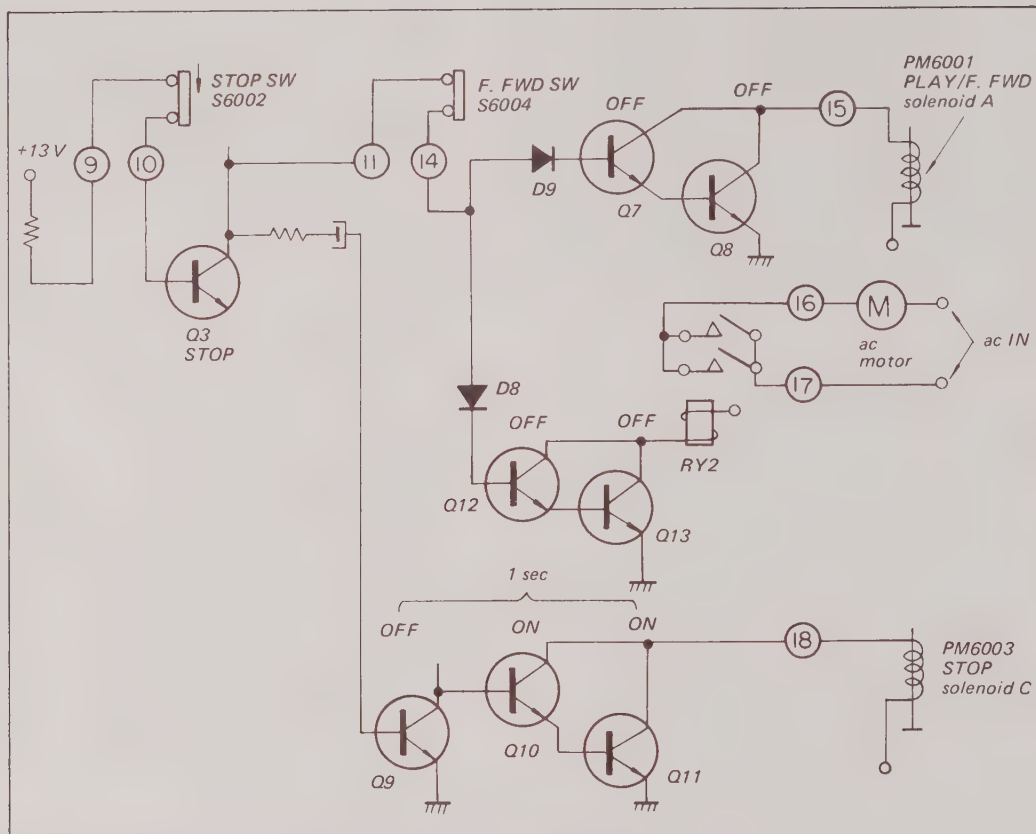


Fig. 3-21. Manual stop during F. FWD mode

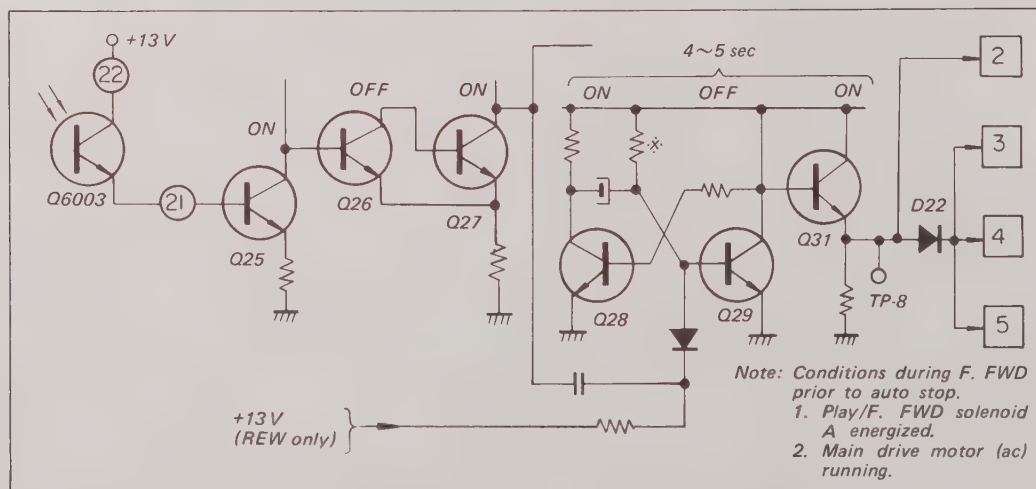


Fig. 3-22 (a). Initiation of auto stop

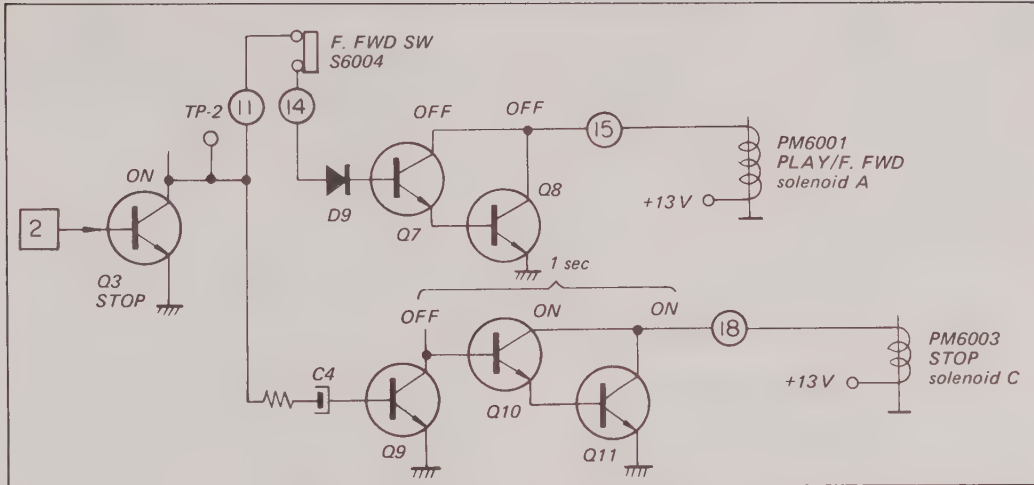


Fig. 3-22 (b). PLAY/F. FWD solenoid releasing

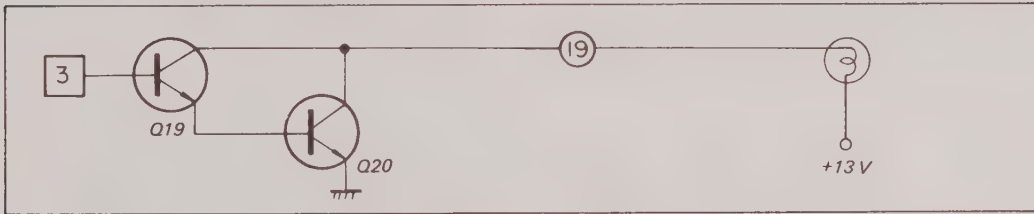


Fig. 3-22 (c). STAND BY lamp on

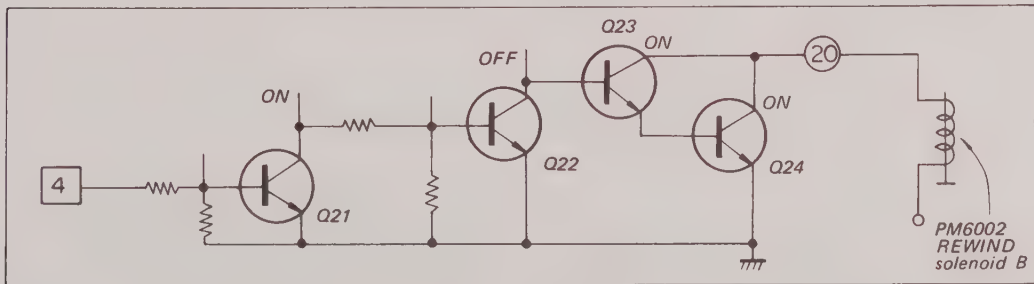


Fig. 3-22 (d). REWIND solenoid on

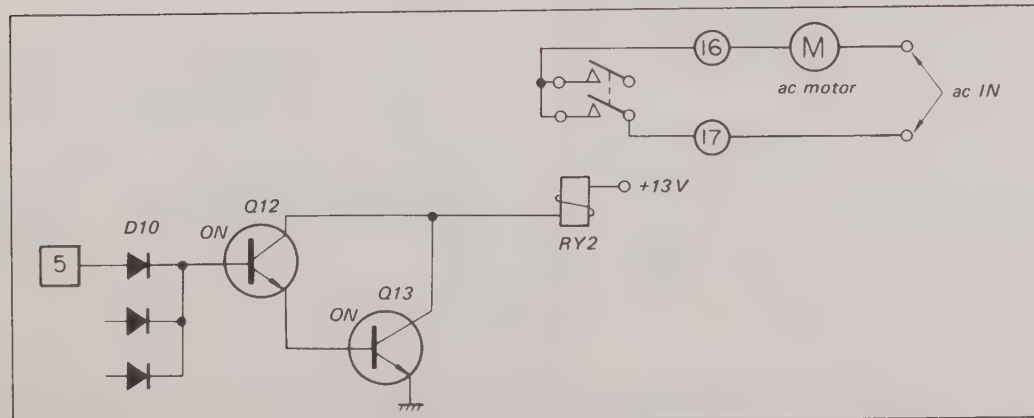


Fig. 3-22 (e). Main drive (a-c) motor on

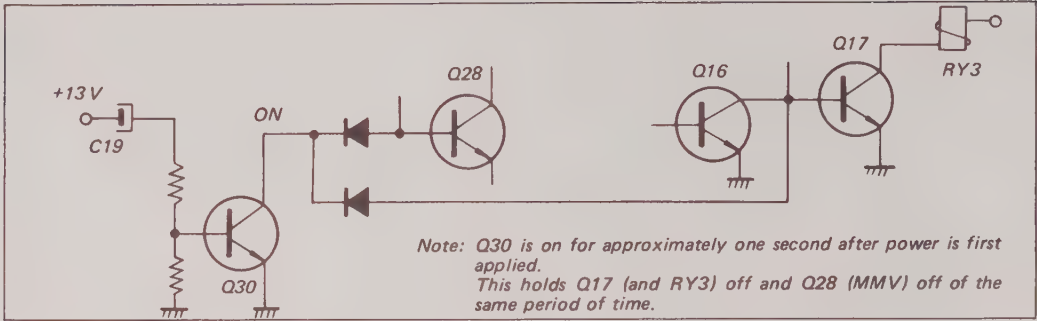


Fig. 3-23. Defeat circuit at power switch ON

3-5-10. Auto-Stop Lamp Burnout Interlock

Production units employing the D-1 Board (after serial number 11,101) include a circuit to shut down the system should the lamp that illuminates the photo burn out or become disconnected.

The ac signal developed by lamp current across

a 1-ohm series resistor R90 is amplified by Q33 and applied to a voltage doubler consisting of D26 and D27. See Fig. 3-24. The resulting dc output of this rectifier holds Q34 conducting in the normal state. If the lamp burns out the signal applied to the rectifier disappears, Q34 cuts off, and a positive signal is applied to Q3 to initiate STOP.

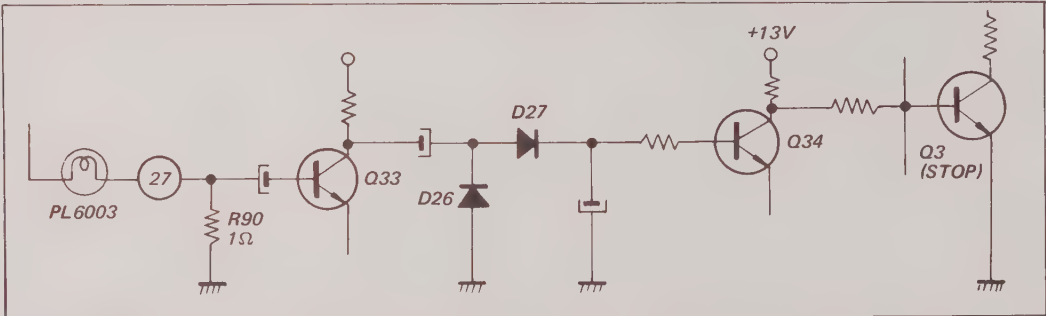


Fig. 3-24. Auto stop lamp interlock

3-5-11. Tape Slack Take-up

Units using the D-1 Board employ the sub circuit shown in Fig. 3-25. The action of this circuit is to activate the ac motor for a short interval when the cassette is dropped into operating position. This applies drive to the Take-Up reel to remove any

slack in the cassette. When the Cassette-In switch S6009 is closed, C23 charges through R89. The voltage developed across R89 is coupled through D25 to turn on Q12 and Q13. Relay 2 is thus energized to activate the ac motor for a fraction of a second.

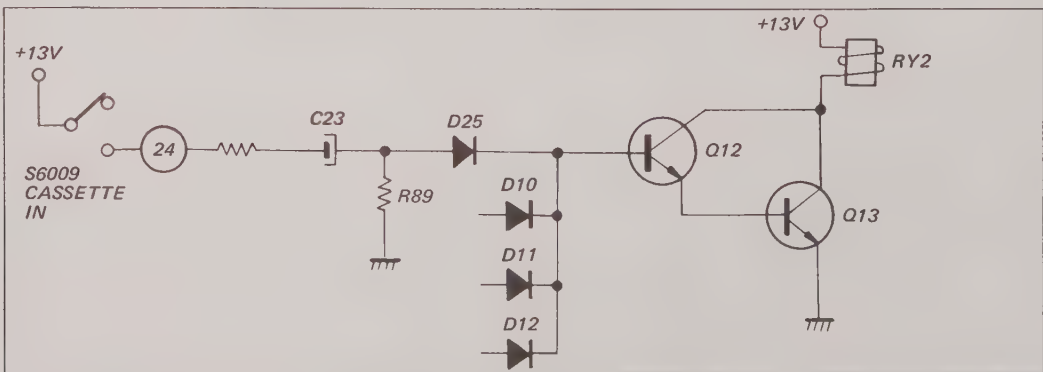


Fig. 3-25. Auto tape-slack removal

3-6. AUDIO CIRCUITS (C-R and H board)

The VO-1600 contains two identical audio record and playback systems to accommodate stereo or bilingual audio. In playback, both channels are operational and supply outputs at the L and R jacks on the rear panel. In addition either left, right, or mixed (L + R) outputs are selected by the VHF AUDIO SELECTOR to be fed to the VHF modulator.

In the record mode, both audio systems are operational when the INPUT SIGNAL SELECTOR is set to EXTERNAL. Since broadcast television is monaural, only one audio channel, Channel 2 (R), is used when the INPUT SIGNAL SELECTOR is set to TV. In the audio dub mode, CH 1 (L), is used exclusively.

Record circuits are mounted on the H board in the record pack along with the bias oscillator mounted on the E board. Playback circuits are mounted on the C-R Board at the rear of the main chassis. In the VO-1600 this board also houses the relays that switch the audio heads between the playback and record circuits.

Since the two audio systems are identical in most sections, the description that follows deal with the left channel except for pertinent differences. Playback circuits are described first.

3-6-1. C-R board

RY1, RY2

Playback signals from the

Amplifiers
Q1, Q2

Equalization Adjust
R12

audio-head RPH6001 feed through the normally closed contacts of RY1 (RY2) to the base of Q1. Transistors Q1 and Q2 provide preamplification and equalization. Low-noise resistors are used in the bias circuit to optimize signal-to-noise ratio. C3 bypasses the input of Q1 at frequencies above the audio range to eliminate demodulation of r-f interference.

Negative feedback from the collector of Q2 via C9, R12, R13 and C25 provides degenerative feedback at high frequencies to equalize playback characteristics. It is adjusted for standard output using 1 kHz and 10 kHz signals recorded on the alignment tape. The bias trap L1 and C8 eliminates bias signals in the E-to-E and record mode. A high-pass filter following C10 removes very low frequency audio components and an emitter

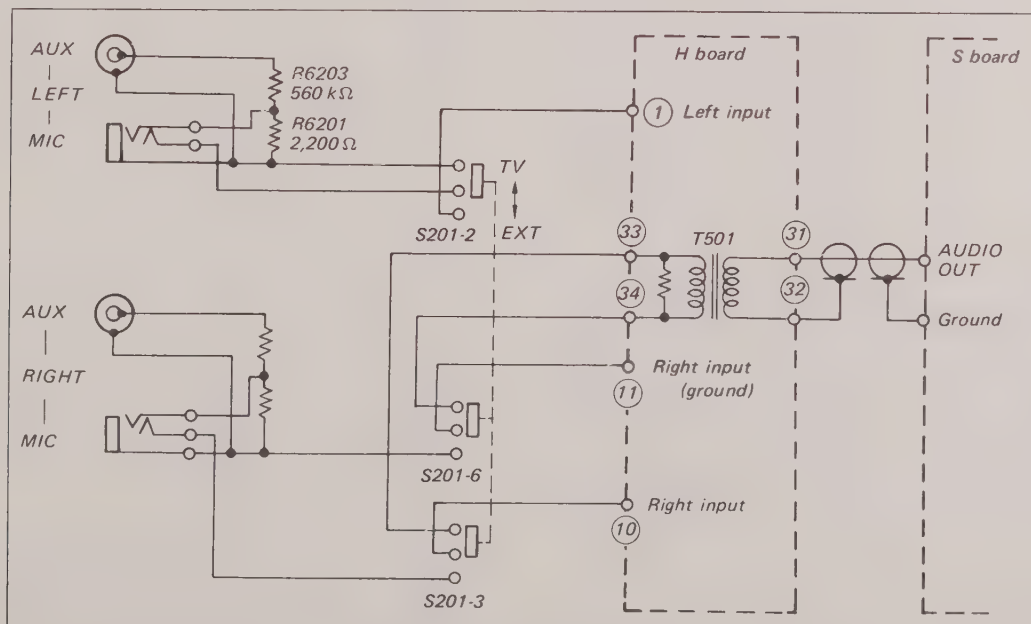


Fig. 3-26. Audio-input circuits

Buffer Q3	follower, Q3, provides the high-pass filter with a high terminating impedance.
Playback Gain R19	The playback gain control, R19 in the emitter circuit of Q3 sets overall gain to provide zero dB output using the 1 kHz signal recorded on the alignment tape. Output signals are measured at the line out terminal, TP-2.
Audio Muting Q4	Q4 is connected across the signal path at the output of the playback gain control. When muting signals are applied from the servo board (+24V during the threading/unthreading cycle) Q4 saturates shorting out audio signals.
Line Amplifier Q5	The line amplifiers provide the additional gain required to provide standard output. The signal at the collector for Q6 drives the audio L output terminal. A bias trap in the collector circuit for Q5 is tuned to 65 kHz.
VHF Buffer Q7	Emitter follower Q7 provides a low-impedance feed to the VHF AUDIO SELECT switch. This switch on the main frame, selects L, R or L + R. The L + R signal is developed in a resistor network. Output for the selector switch feeds the audio input terminal of the VHF modulator.

Record input circuits are shown simplified in Fig. 3-24. External audio from a high level source may be applied to the AUX IN phono jacks. This signal is attenuated by R6203 and R6201 to microphone level to permit use of a common preamp. The AUX IN jack is disconnected by the shorting microphone jack if a microphone plug is inserted. Externally-supplied signals are then routed through S201-2, the INPUT SIGNAL SELECTOR, to the preamp in the H board. Note that left-channel external audio is shorted out by S201-2 when the switch is set to TV.

A similar arrangement is used for the right channel as shown at the bottom of Fig. 3-24.

However ground as well as the hot side of the line is switched by S201-6 and S201-3. In the TV position of S201, audio from the tuner (S board) is selected. A matching transformer, T501, on the H board adjusts impedance levels to those required at the input to the right preamp.

3-6-2. H Board

Preamplifier Q201, Q203	Input audio from S6201 applied to the H board is applied by the low-noise preamp Q201 and Q203. Dc feedback from the collector of Q203 to the emitter of Q201 via R210 for bias stabilization purposes. Ac feedback via C210 and R205 improves linearity and raises the input impedance of Q201.
Audio AGC Control Q202	AGC control is achieved by voltage divider action between the output impedance of Q201 and the collector-to-emitter impedance of Q202. The latter is controlled by bias derived from the AGC detector.
Buffer Q204	Output from the preamp is buffered by emitter follower Q204 to feed the remaining amplifiers Q205 to Q206. This section is powered only in the E-to-E, record and audio dub modes. (in the right channel Q305 to Q307 is powered only in the E-to-E and record modes.)
Drivers Q205, Q206	Amplifiers Q205 and Q206 provide sufficient gain to drive the output stage and the AGC detector.
E-to-E Level R217	R217 sets the level of signal routed to the C-R (playback circuits) Board for E-to-E operation.
Record Level R228	R228 determines the level of signal applied to the record amplifier and so determines record level.

Record Amplifier Q207

Q207 applies output signal to the left audio head via the E board. The output stage employs a tuned circuit in the emitter leg for record equalization. This circuit is adjusted for uniform record/playback response. The E board contains the Bias Oscillator operating at 65 kHz. The left record current appears at pin 12 of the E board and goes through a parallel resonant bias trap L401 and C407 to pin 7. Bias signals are added to the audio by C405; the sum is applied to the left audio head via the C-R board. Relays RY-1 and RY-2 on the C-R board are energized in the record mode applying audio plus bias signals to the record/playback heads.

Bias Level C405

Audio AGC Q209 (Q308)

Q209 operates as a detector. It has zero base bias and receives an audio feed from the collector of Q206 via C226. Thus the average collector current used to charge C233 is proportional to audio level. The control voltage thus developed is buffered by Q210 and applied to the AGC Balancer potentiometer R249. This resistor balances the amount of AGC applied to the left (Q202) and right (Q302) AGC control stages.

AGC Buffer Q210

Audio Record Muting Q208, Q211

The E-to-E signal feed and the AGC system is muted at the beginning of the record interval to prevent switching transients from appearing in the audio output or setting-up the AGC system. When the record button is pressed, +24 volts appears at pin 13 of the H board. Charging current of C237 and C225 holds on Q208 in saturation

until the capacitors are charged fully. Q208 shorts the E-to-E signal feed during this interval. Similarly C234 in the base circuit of Q211 driving this transistor into saturation until the capacitor is charged fully. Q211 directs the AGC voltage at the emitter of Q209 to ground through D203 and R253 during this time interval.

3-7. POWER SUPPLIES

The power supply in the VO-1600 contains three regulators providing DC outputs at +24 V, +13 V, and +12 V. The 24-volt supply is used by most of the circuits and is distributed to the A-R, K, B-R, C-R, E, S and V boards. Rated load current is 850 mA in REC mode. The VHF Modulator is supplied with +12 volts, at a rated load of 80 mA. A separate rectifier and regulator supplies +13 volts at a rated load of 1.2 A to System Control (D Board). Circuit details are as follows:

T6001

Power transformer T6001 employs two secondaries supplying 26.5V and 14.5V AC. A tapped primary permits operation on 120V or 100 volts. However sets made for use in the U.S. are wired for 120-volt operation.

Bridge Rectifier D101, D102

The bridge formed of two double-diode units supplies d-c input to the 24-volt series regulator.

+24V Regulator Q6001, Q101, Q102, D103

A sample for the 24-volt output at pin 8 is compared with a reference voltage developed across Zener diode D103 by Q102. A change in output voltage, detected by Q102 results in a change in the conduction of Q101 and Q6001 that offsets the original voltage shift.

+24V Adjust R104

R104 is set for a loaded output voltage of +24 volts $\pm 0.2V$.

+12 Volt Regulator Q103, Q104, D104	This series regulator is in series with the 24 volt supply. Voltage drops across R107 and Q103 reduces the supply voltage to +12 volts. Circuit operation is similar to that described for the 24 volt regulator except that no pre-regulator is used to drive the series regulator Q103.
+12 V Adjust R110	R110 is set for a loaded output voltage of +12 volts $\pm 0.2V$.
+13 Volt Regulator D105 – D108, Q105, Q106, D109, Q6002	A separate bridge rectifier D105 – D108 supplies the dc input to the 13-volt regulator. This circuit is similar in operation to the 12-volt supply except for the designed load current.
+13V Adjust R114	R114 is set for a loaded output voltage of 13 volts $\pm 0.2V$.

3-8. VHF MODULATOR

The VHF modulator is essentially a miniature TV transmitter. It contains AM and FM modulators to place the video and audio signals in the channel passbands of Channel 3 or 4. Channel switching is accomplished by diodes using d-c control circuitry. Circuit details are as follows:

Carrier Oscillator Q5	The carrier oscillator is a common base Colpitts type using collector-to-emitter feedback via C20. Oscillation occurs at the frequencies at which the base impedance is minimum. This, in turn is determined by crystals X1 and X2 which operate at one half the Channel 3 and Channel 4 picture carrier frequencies respectively. Crystal selection is accomplished by a channel selector switch as follows: In the CH-3 position of the switch, terminal 4 of the modulator is grounded. D5 is then forward biased by the positive voltage applied at its
Frequency Selectors D5, D6	

Frequency Doubler Q6

diode via L6. This returns X1 to r-f ground via C17. In the CH-4 position of the selector a positive 12 volts is applied to terminal 4. This cuts off D5 and places a forward bias on D6 via L7 and L8. Thus X2 is returned to r-f ground via the low impedance of D6 and C17. Inductors L6, L7, and L8 act to isolate the r-f circuits from the diode bias supplies.

Signals developed at the collector of Q5 are amplified by Q6 whose collector circuits is tuned to the second harmonic of the oscillator. In the CH-4 position of the channel selector, D7 is open and the primary of T2 tunes to 67.25 MHz. In the CH-3 position the cathode of D7 is grounded adding C25 to the tank circuit, thereby reducing the frequency of operation to 61.25 MHz.

The secondary of T2 feeds picture carrier signal to the A-m modulator via C28 and to a frequency converter via C29.

Video Amplifiers Q1, Q2

Amplifiers Q1 and Q2 raise the video signal to the level required to drive the modulator. Input signals are clamped by D1 to the dc voltage developed across C4. R2 establishes the amplitude of signal and so determines percentage of modulation. It is set for 75% modulation. The linearity of Q1 is determined by D2 connected between the emitter and R6.

Black Stretch Adjust R6

The control R6 is set for maximum linearity in the modulated signal.

Buffer Q3

Emitter follower Q3 acts as the modulator driver to supply a low impedance source of signal to the emitter

AM Modulator Q4	circuit of the modulator. The modulator Q4 is biased for nonlinear operation, modulates the video (sync negative) applied at the emitter by the picture carrier signal applied at the base. The collector circuit of Q4 contains a bandpass circuit that tunes to the upper sideband of the selected channel and that fraction of the lower sideband that provides vestigial sideband transmission.	Fm Modulator Q10	The fm modulator is an extremely stable 4.5 MHz oscillator that is frequency modulated by means of a variable capacitance diode D11. The oscillator is a Colpitts type using collector-to-base feedback via C50 and C51. Supply voltage for the oscillator is regulated by Zener diode D10 and the bias supply for the variable capacitance diode is compensated for thermal variations by thermistor TH-1.
Channel Select Diodes D3, D4	Channel selection is performed by diodes D3 and D4. When the cathodes of these diodes are returned to ground by the channel selector switch (CH-3 position), added capacitance is placed across the tuned circuits of the filter. R-f output signal is tapped off at the low-impedance tap on T1 and applied to a pi-pad R21, R22, and R23, that reduces signal to the required output level.	Sound Carrier Level R64	Signal output of the 4.5-MHz oscillator/modulator at the secondary of T5 is adjusted by R64 for the correct amplitude with respect to the picture carrier signal (13 dB below the picture carrier level). Output of R64 is applied to the frequency converter Q7. Here the 4.5 MHz from signal is heterodyned with the picture carrier signal to produce the sound carrier signal.
Audio Level R47	Audio input from the VHF AUDIO SELECT switch is applied to R47 which establishes the level of signal applied to the fm modulators. It is set for a modulation factor of at least 90% with a -6 dBm signal applied to the audio input terminal.	Frequency Converter Q7	The primary of T3 is tuned to 71.75 MHz with C31. When the channel selector is set to CH-3, D8 conducts to add C33 and C34 to the tank circuit to reduce the operating frequency to 65.75 MHz. Signal output from the frequency converter is amplified by Q8 to the proper output level. The collector circuit of Q8 is tuned by the same type of arrangement described in conjunction with Q7.
Audio Amplifier Q9	Amplifier Q9 raises the Audio signal level to the value required to drive the fm modulator.	Sound R-F Amplifier Q8	

SECTION 4 DISASSEMBLY

4-1. TOP COVER REMOVAL

1. Remove the three screws at the rear-top edge of the top cover. See Fig. 4-1. A 2.5 mm hex key is needed for this purpose.
2. Lift off the top cover.

4-2. CABINET REMOVAL

1. Lift the side of the cabinet and remove the eight screws at the bottom of the cabinet. See Fig. 4-2.
2. Remove the two screws at the rear of the cabinet as shown in Fig. 4-1.
3. Remove the top cover as described in Procedure 4-1.
4. Grasp the chassis as shown in Fig. 4-3, and lift the chassis out of the cabinet.

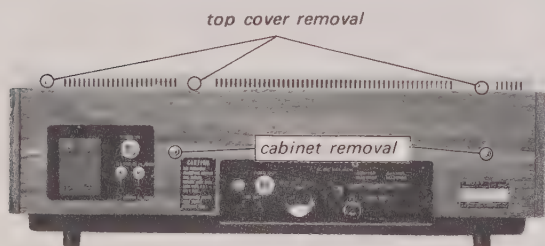


Fig. 4-1. Rear view

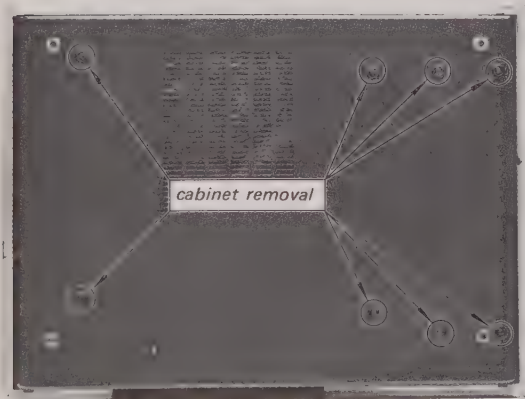


Fig. 4-2. Bottom view

4-3. CONTROL PANEL REMOVAL

1. Lift the cassette loading compartment by pulling the EJECT lever toward you.
2. Remove the two screws from both sides of the loading compartment as shown in Fig. 4-4. This frees the top cover of cassette loading compartment.
3. Pull off the knobs for the EJECT lever, SKEW control, TRACKING control, UHF and VHF tuner.
4. Remove the six screws shown in Fig. 4-5.
5. Lift off the control panel.

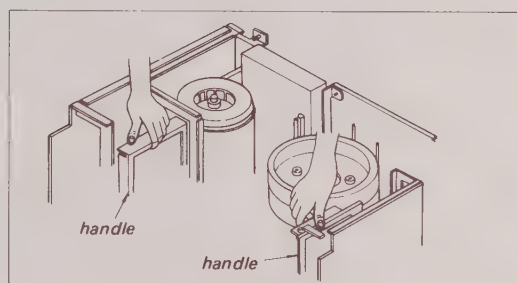


Fig. 4-3. Chassis removal

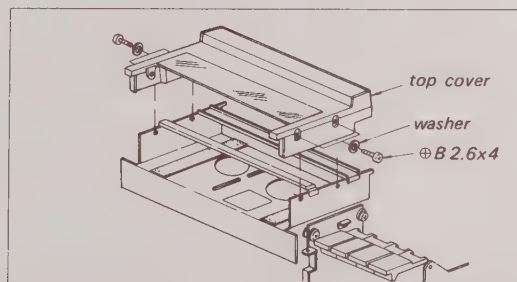


Fig. 4-4. Top cover removal of cassette loading compartment

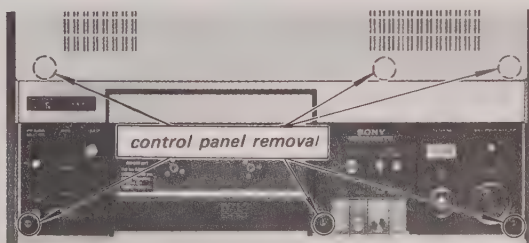


Fig. 4-5. Top view

4-4. RECORD-PACK REMOVAL

The record pack is mechanically free of the main chassis when the steps in Sections 4-2 and 4-3 have been completed.

To gain access to the G board for service, pull out the phono jacks near the tuning meter (VHF antenna leads to the RECORD switch) and swing the Record Pack away from the main chassis.

To service the Record pack in the TV mode, connect a short jumper between the hot leads of the phono jacks near the tuning meter. This completes VHF antenna input connections.

4-5. CASSETTE LOADING COMPARTMENT ASSEMBLY REMOVAL

1. Remove the four +P 3x6 screws that secure the cassette holder to the chassis.
2. Lift off the cassette loading compartment assembly.

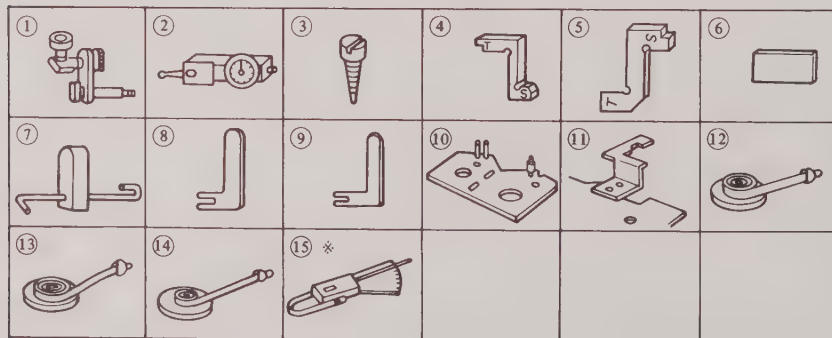
Note: Jig Code Numbers are stamped on the jigs.

* All spring gauges are available from local sources in U.S.

JIG TABLE

Description	Part No.		Jig Code No.	Reference Sketch No.
	Former	New		
Upper Head Drum Alignment Jig	X-03261-04-0 VA-0052	3-702-211-01	TD-052	①
Eccentricity Gauge (should be used with upper head drum alignment jig)		7-732-040-10		②
Dihedral Adjustment Screws (4)	0-324-059-00 VA-0051	3-702-210-01	TD-051	③
Reel-Table Height Adjustment Jig	0-328-121-01 VA-0047	3-702-207-01	TD-047	④
Tension-Arm Height Adjustment Jig	0-328-091-00 VA-0017	3-702-206-01	TD-046	⑤
Audio/Control Head Adjustment Jig	0-328-067-00 VA-0004	3-702-201-01	TD-004	⑥
Threading Ring Drive Pulley Retraction Jig	0-327-170-00	3-702-222-01	TD-513	⑦
Tension Arm T Bending Jig	0-327-108-00 VA-0027	3-702-204-01	TD-027	⑧
Tension Arm S Bending Jig	0-328-107-00 VA-0026	3-702-203-01	TD-026	⑨
Back Tension Adjustment Jig	X-03282-41-0 VA-0058	3-702-216-01	TD-058	⑩
Tension Arm Position Jig	X-36322-44-0 VA-0049	3-702-224-01	TD-530	⑪
Dummy Reel Pack (100 mm dia) (reel table torque adj.)	VA-0056	3-702-215-01	TD-056	⑫
Dummy Reel Pack (118 mm dia) (forward back tension adj.)	VA-0055	3-702-214-01	TD-055	⑬
Dummy Reel Pack (39 mm dia) (forward back tension adj.)	VA-0054	3-702-213-01	TD-054	⑭
*Spring Gauge (20 g maximum)		7-732-050-10		⑮
*Spring Gauge (50 g maximum)		7-732-050-20		⑮
*Spring Gauge (100 g maximum)		7-732-050-30		⑮
*Spring Gauge (200 g maximum)		7-732-050-40		⑮
*Spring Gauge (500 g maximum)		7-732-050-50		⑮

JIG SKETCHES



SECTION 5

MECHANICAL MAINTENANCE

PRECAUTIONS

1. To operate the deck while it is out of the cabinet, and with no cassette in place, short the terminals of the Cassette Loaded micro-switch S6009 with a short clip lead. The switch is located at the front of the machine, just forward of the take-up reel spindle.
2. To operate the deck without a cassette, it is necessary to disable the photo transistor that activates the auto stop system. A cap of black opaque material placed over the photo transistor will disable the auto stop system. The cap of a ball-point pen will suffice.
3. To operate the deck with the Cassette loading compartment removed, be sure that the cassette is seated properly on the reel spindles. There should be no space between the reel turntables and the bottom of the reel hubs inside the cassette.
4. Stand the deck in the normal operating position for service or on the side of the deck close to the power switch (left side as you face the front of the machine). Do not stand the deck on any other side.
5. Machine compatibility (interchangeability of tapes between individual machines) depends upon very close mechanical tolerances. The tape path and threading mechanism are factory adjusted and should not require realignment under normal circumstances. Therefore, do not attempt adjustment of the tape guides or the threading guides.
6. Use utmost care in replacing parts on or near the tape guides, head drum assembly or the threading guides. The slightest deviation in the tape path can make the rotating video heads fail to track the paths of previous recordings.

TABLE 5-1. JIGS REQUIRED FOR MECHANICAL ADJUSTMENTS

Description	Part Number	Remarks
Alignment Tape (RR-5-1)	96-0005-01	Tape Pass and Electrical Adj.
Upper Head Drum Alignment Jig	3-702-211-01	Upper Head Drum Replacement
Eccentricity Gauge	7-732-040-10	
Dihedral Adjustment Screws (4)	3-702-210-01	-----
Reel-Table Height Adjustment Jig	3-702-207-01	-----
Tension-Arm Height Adjustment Jig	3-702-206-01	-----
Audio/Control Head Adjustment Jig	3-702-201-01	Head Azimuth Adj.
Tension Arm T Bending Jig	3-702-204-01	Tension Arm, Tape Guide Adj.
Back Tension Adjustment Jig	3-702-216-01	-----
Tension Arm Position Jig	3-702-224-01	-----
Tension Arm S Bending Jig	3-702-203-01	Tension Arm, Tape Guide Adj.
Dummy Reel Pack (39 mm dia)	3-702-213-01	Playback Tension Adj. at tape end
Dummy Reel Pack (118 mm dia)	3-702-214-01	Playback Tension Adj. at tape start
Dummy Reel Pack (100 mm dia)	3-702-215-01	REW, FF and FWD Torque, Brake, REW Back Tension, Threading Back Tension, Threading Brake

Note: To avoid confusion, use new part number when ordering adjustment jigs.

7. If it is necessary to rotate the Threading Ring by hand to check for mechanical action, do not grasp the tape guides. Insert the tip of a Phillips-head screwdriver into one of the holes in the Threading Ring and push the Threading Ring around with the screwdriver.
8. If it is necessary to rotate the ac drive motor by hand, turn it in the direction shown by the arrow affixed to the motor fan. If the motor is turned in the opposite direction, one of the drive belts will work its way off the pulley.
9. To disable the Record Safety Switch, S6016, hold the actuator wire down with a short length of adhesive tape.

5-1. CLEANING THE PLAYBACK HEADS AND TAPE PATH

Video heads can be cleaned by playing the Cleaning Cassette KC-IC. Do not play the Cleaning Cassette for more than 30 seconds (a count of 10 on the tape counter). Do not rewind the Cleaning Cassette after each pass but rewind the cassette completely after it has been used once throughout its length. The cleaning cassette is good for four or five passes, it should then be replaced.

For routine shop maintenance it is recommended that the video heads, audio/control track heads, the tape bearing surface of the rotary head drum assembly and all tape guides be cleaned by wiping the surfaces with a piece of chamois saturated with methanol or M/S-Brand magnetic head cleaner.

WARNING

Never try to clean the heads with the motor running.

5-2. DEGAUSSING

Demagnetize video, audio and control track heads with a head demagnetizer. Bring the tip of the demagnetizer as close as possible to the head tip without actually contacting the head tip. Withdraw the demagnetizer very slowly and turn off power after the demagnetizer is at least three feet away from the deck.

CAUTION

The demagnetizer should not be allowed to touch the video heads.

5-3. LUBRICATION

To lubricate the Reel Table shafts, remove the 3 mm screw and washer at the top of the shaft. Lift the Reel Table slightly and apply one drop of oil to the inner surface of the Reel Table bearing. This should be done if the Reel Table does not turn smoothly and when a new Reel Table is installed. See Fig. 5-1.

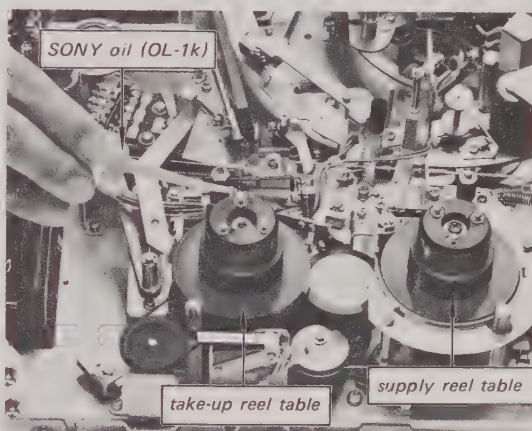


Fig. 5-1. Lubrication of the reel tables

5-4. VIDEO HEAD REPLACEMENT

Video head replacement is required when the heads are damaged or have open coils. In addition, insufficient tip penetration, resulting from head wear after long periods of operation, may necessitate replacement. Heads are replaced by replacing the upper Head-Drum Assembly. Do not attempt replacement of individual head chips. To remove and replace the rotary Head Assembly (the upper cylinder on which the two video heads are mounted) proceed as follows:

CAUTION

The video Head Assembly and the surrounding machined parts are very precisely made. Use utmost care when performing any work on the rotary head drum assembly.

Removal

1. Turn off the power.
2. Unsolder the two white and two red wires where they are connected to the terminals of the rotary transformers.

3. Hold the upper drum assembly to keep it from rotating and remove the two Phillips head screws that secure the upper Head-Drum Assembly to the drive flange.
4. Lift off the upper Head-Drum Assembly.
DO NOT remove the shim on the mounting flange.
DO NOT loosen the hex nut on the spindle of the drive shaft.

Replacement

1. Wipe the replacement upper Head-Drum Assembly with a lint-free cloth dampened with alcohol to clean the outer circumference and the bottom surface.
2. Place the upper Head-Drum so that the hole through which the white leads extend is close to the small drill mark on the mounting platform. Position the upper Head-Drum over the mounting holes.
3. Install the Phillips-head screws that secure the upper Head-Drum Assembly. Thread them snug, but do not tighten.
4. Solder the red and white leads to the terminals of the rotary transformer.
5. Install the Eccentricity Gauge as shown in Fig. 5-2 by threading the lower part of the fixture into the threaded hole on the lower Head-Drum Assembly near the entrance guide, as shown in Fig. 5-3. Tighten the knurled parts securely.
6. Adjust the gauge mount so that the tip of the actuating lever bears against the circumference of the upper Head-Drum Assembly between the two lower grooves on the Head-Drum Assembly.

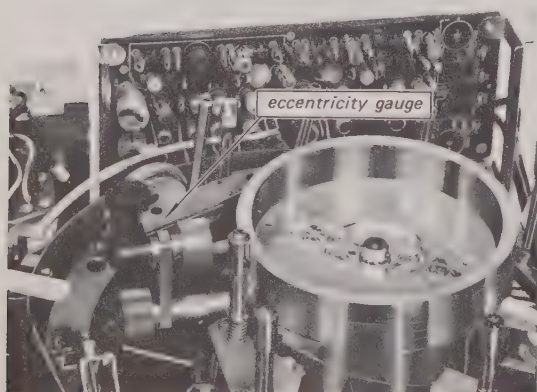


Fig. 5-2. Installation of the eccentricity gauge

The dial reading should be made to increase by 30 – 50 units compared with the reading when the actuating lever is not in contact with the surface.

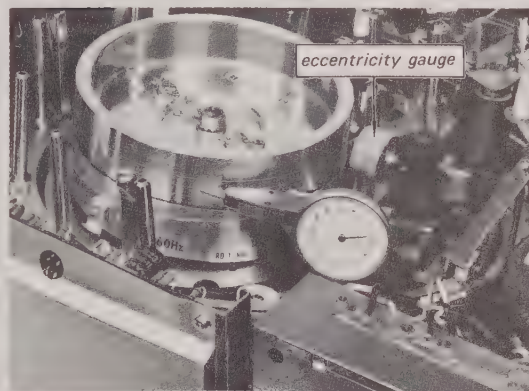


Fig. 5-3. Operation of the eccentricity gauge

7. Rotate the Head-Drum Assembly by turning the fan mounted on the motor shaft in the direction indicated by the arrow on the fan.
8. Check total eccentricity. It should not exceed 10 microns peak to peak. If it does, proceed to the next step.
9. Rotate the Head-Drum Assembly until the gauge indicates greatest deflection. Tap the inner circumference of the upper Head-Drum Assembly lightly with the plastic handle of a screwdriver at a point 180° away from point where the gauge touches the head drum.
10. Test for eccentricity and repeat Step 9 until the total deflection is less than 10 microns.
11. Tighten the mounting screws gradually while repeating the eccentricity test. Make a final test when the screws are fully tightened.
12. Remove the Eccentricity Gauge and fixture.

Video Head Dihedral Adjustment

Dihedral adjustments are very seldom required when replacing the Upper Head-Drum Assembly. However, if dihedral is incorrect (heads are not precisely 180° apart) a form of distortion shown in Fig. 5-4 (a) will be seen on the monitor during playback. This condition is seen more readily on monitors with relatively long time constant filters in their horizontal AFC circuits.

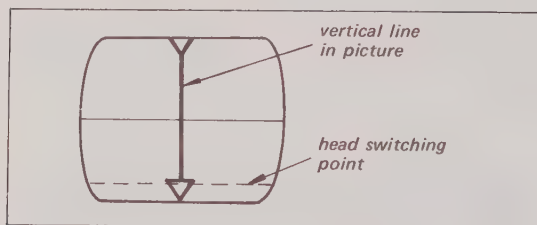


Fig. 5-4 (a). Dihedral error appears as a stationary split in vertical lines in the picture. It is most evident at the switching point and continues at the top of the picture.



Fig. 5-4 (b). Dihedral error correction

To adjust dihedral, it is necessary to install tapered adjustment screws at the threaded holes on either side of the video head assemblies. See Fig. 5-4 (b). The part number for these adjusting screws is 3-702-210-01.

1. Install screws in each of the four holes, but do not run them all the way down. Four screws are needed to maintain balance even if only one of the screws requires adjustment.
2. Turn one of the screws down until the screw touches the head base. Turn this screw one additional quarter turn.
3. Playback the Alignment Tape and check for dihedral distortion at the top of the picture (or at the bottom, at the switching point).
4. If the situation has improved, turn off the deck and advance the screw identified in Step 2 another quarter turn. Continue Steps 3 and 4 until all dihedral error is removed.

5. If the situation got worse in Step 3, unscrew the screw identified in Step 2 and turn down the screw on the opposite side of the same video head. Advance this screw in quarter turn steps, and check playback between each step.
6. Remove the tapered screws when adjustment is complete.

5-5. PG COIL REPLACEMENT

There are two 30 PG coils beneath the Upper Head-Drum assembly. To replace either coil, proceed as follows:

1. Unsolder the leads of the defective PG coil where they connect to the terminals of the B-R board.
2. Remove the two P4 x 10 screws that secure the Upper Head-Drum Assembly to the rotating platform. Remove the Upper Head-Drum Assembly. See Fig. 5-5.

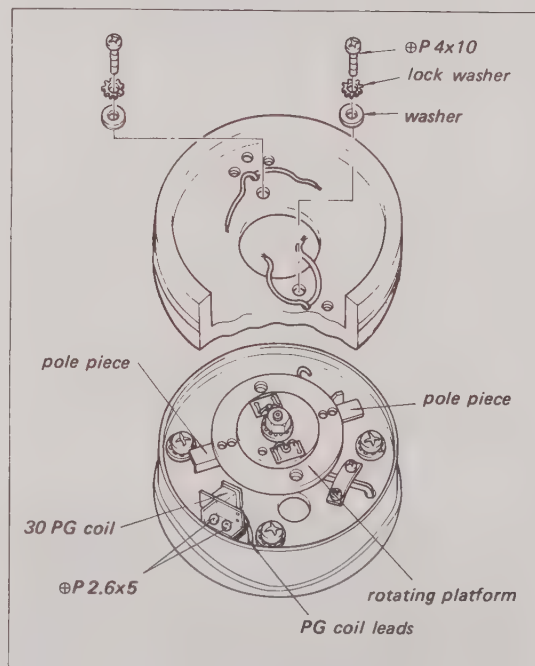


Fig. 5-5. 30 PG coil replacement

3. Remove the two P2.6 x 5 screws that secure the defective PG coil bracket to the Lower Head-Drum Assembly. If a spacer is used under the original coil, leave it in place.
4. Feed the leads for the new coil through the hole in the Lower Head-Drum Assembly and solder these leads to the correct terminals on the B-R board.

5. Install the two P2.6 x 5 screws and align the poles of the coil with the pole piece mounted on the rotating platform. Position the platform so that the two pole pieces are aligned perfectly with both 30 PG coils and adjust the position of the new coil so that it is 180° away from the remaining coil. Use the pole piece assembly as a guide.
6. Check the clearance between the poles of the new coil and the pole pieces. Clearance should be between 0.1 to 0.4 mm. Add or remove spacers as necessary.
7. Reinstall the Upper Head-Drum Assembly as directed in Section 5-4.
8. Reset head switching as directed in Section 7-5.

5-6. AUDIO/CONTROL-HEAD REPLACEMENT

A defective audio/control head can be replaced without upsetting servo tracking as follows: Height, azimuth and tilt will have to be adjusted, however.

1. Unsolder the leads at the rear of the audio/control head.
2. Remove screws A and B shown in Fig. 5-6. Do not lose the spring under screw A. Do not loosen the screws in the long slots.
3. Install the Head Mounting Plate Assembly using the original screws A and B. The spring on screw A goes between the head of the screw and the mounting plate. Keep the original spacer beneath the head assembly.

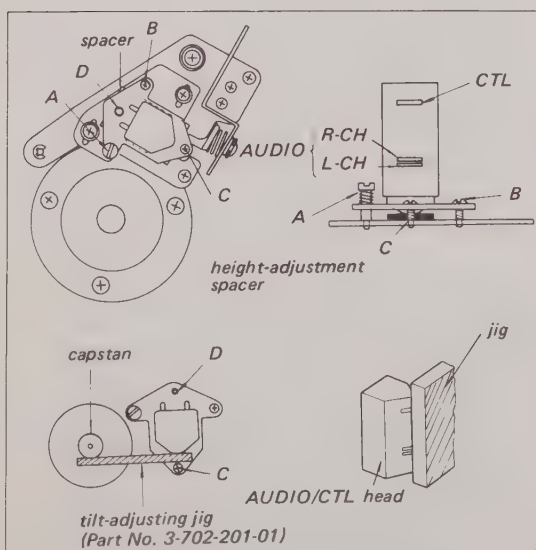


Fig. 5-6. Audio/Control head replacement and adjustment

4. Adjust the front surface of the head to be paralleled with the capstan using screws C and D. Adjustment jig (Part No. 3-702-201-01) is used to set parallelism between the capstan and the head as shown in the lower details of Fig. 5-6.
5. Reconnect the leads at the rear of the Audio/Control Head.
6. Connect a scope or ac VTVM to TP-2 or TP-102 of the C-R board. Playback the 10 kHz segment of the Alignment Tape.
7. Adjust the height of the head, using appropriate spacers for maximum output. There are four spacers available as follows:

Part No.	Thickness
3-630-483-01	1.2 mm
3-630-483-11	0.5 mm
3-630-483-21	0.2 mm
3-630-483-31	0.1 mm

8. Playback the 10 kHz segment of the Alignment Tape and adjust azimuth using screw B (screw A should be fully tightened) for maximum output.
9. A precise adjustment of azimuth can be done by using a scope with identical horizontal and vertical amplifiers and connecting the vertical and horizontal inputs to TP-2 and TP-102 of the C-R board respectively. Playback the 10 kHz segment of the Alignment Tape and adjust azimuth (screw B) for zero phase as indicated by a 45°-line Lissajous pattern.

5-7. ERASE HEAD REPLACEMENT

1. Remove the shield plate for erase head by loosening the screw A shown in Fig. 5-7.
2. Unsolder the leads at the rear of the erase head.
3. Remove the screw B shown in Fig. 5-7. Do not lose the spring under screw B. Do not loosen the screw C. This frees the erase head along with its housing.

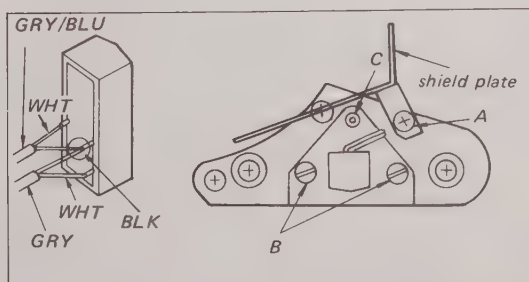


Fig. 5-7. Erase head replacement

4. Install the new erase head to the housing, and then reverse the foregoing procedures. The spring on screws B goes between the head of screw and the housing.
Keep the original spacer beneath the housing.
5. Adjust the height of the head, using appropriate spacers to make the top and bottom edge of the erase head cores appears equally as shown in Fig. 5-8. There are five spacers available as follows:

Part No.	Thickness
3-630-031-01	0.1 mm
3-630-031-11	0.2 mm
3-630-031-21	0.5 mm
3-630-031-31	1.0 mm
3-630-031-41	0.05 mm

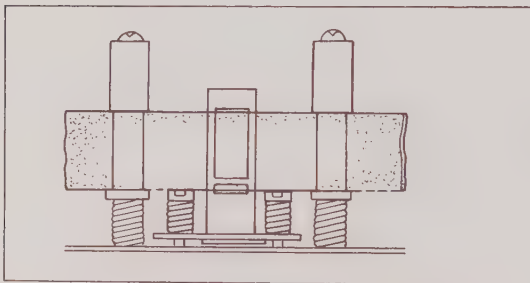


Fig. 5-8. Erase head height adjustment

6. After completing the head height adjustment, perform angle adjustment by loosening the screw B as shown in Fig. 5-9.

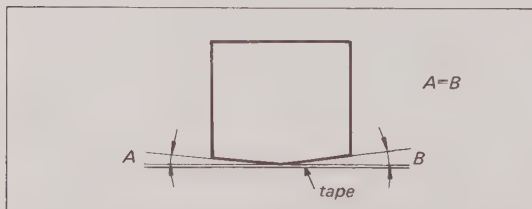


Fig. 5-9. Erase head angle adjustment

5-8. AC MOTOR REPLACEMENT

1. Remove the four PS3 x 6 screws that secure the diagonal chassis brace. Remove the brace.
2. Remove the three drive belts from the motor pulley.
3. Loosen the two 3 mm set screws and pull off the drive pulley.

4. Remove the screws at the top edge of the A-R board and swing the top of the board out and down to gain access to the terminal strip.
5. Unsolder the motor leads at the terminals numbered 1, 2 and 3.
6. Remove the four 4 mm screws that secure the motor to the chassis. Lift out the motor.
7. Transfer the shield belt from the old motor to the replacement.
8. Install the new motor so that the leads come out adjacent to the terminal strip. Install the four 4 mm mounting screws.
9. Solder the leads to the terminal strip as follows: White - 1, Black - 2, Green - 3
10. Install the motor pulley and adjust the distance between the pulley and the chassis as shown in Fig. 5-10. Tighten the two set screws.
11. Reinstall the drive belts. The dull sides of the two flat belts ride against the pulley drive surfaces.
12. Perform head drum free-running speed check as described in Procedure 7-1.
13. Replace the diagonal chassis brace.

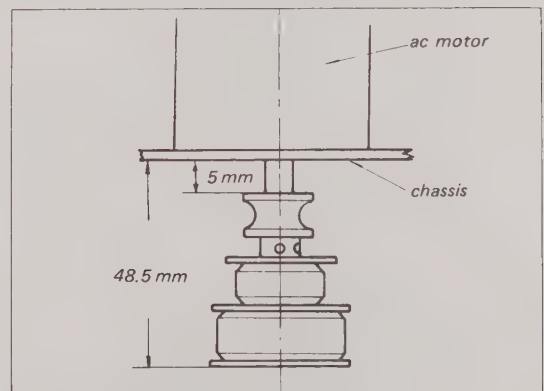


Fig. 5-10. Motor pulley height setting

5-9. PINCH ROLLER REPLACEMENT

Replace a worn or damaged pinch roller as follows:

1. Remove the two M3 x 6 knurled Allen-Head screws B on the Pinch Roller Assembly. See Fig. 5-11 (a).
2. Install the replacement pinch roller assembly using the same screws. The screws may be made snug temporarily until the next adjustments are completed.

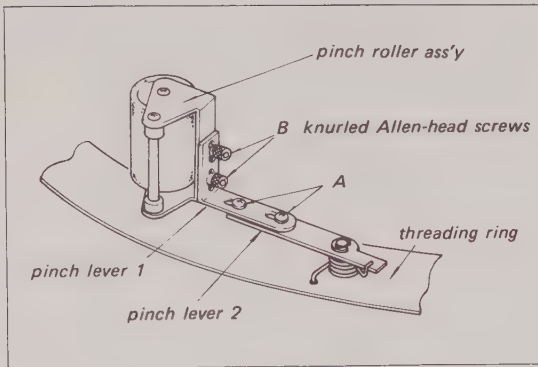


Fig. 5-11 (a). Pinch roller replacement and adjustment

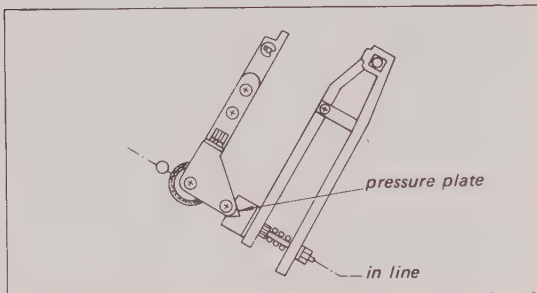


Fig. 5-11 (b). Pinch roller replacement and adjustment

3. Move the Threading Ring by hand to the play position. Loosen the screws A in Fig. 5-11 (a) and set the Pinch Roller Pressure Plate, the Pinch Roller and the Capstan in a straight line. See Fig. 5-11 (b). Tighten the screws A.
4. Loosen the knurled Allen-head screws B and adjust the Pinch Roller to be parallel with the capstan while adjusting the height of the Pinch Roller Assembly so that the Pressure Plate is centered vertically against the Pinch Roller Assembly. Tighten the knurled Allen screws B.
5. Check to see that the Pinch Roller is parallel with the capstan as shown in Fig. 5-11 (c). Install a shim between Pinch Lever parts 1 and 2 to effect parallelism.
6. Move the Pressure Plate by hand to press the pinch roller against the Capstan. If the top and bottom of the pinch roller do not press equally against the capstan, loosen the knurled Allen-head screws on the Pressure Arm and adjust the Pressure Plate using an RT spacer as shown in the detail of Fig. 5-11 (d).

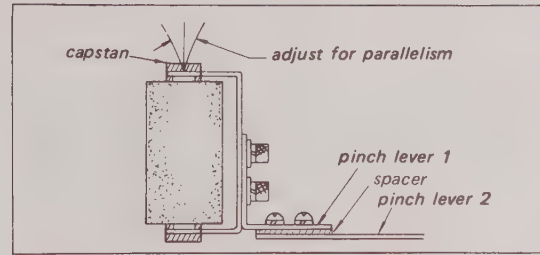


Fig. 5-11 (c). Pinch roller replacement and adjustment

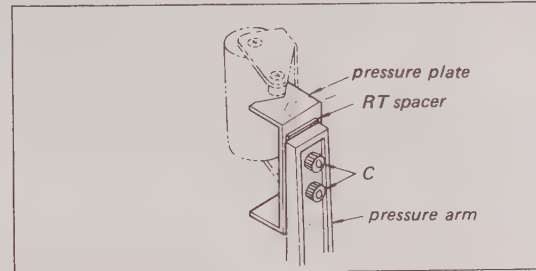


Fig. 5-11 (d). Pinch roller replacement and adjustment

5-10. FAST FORWARD/REWIND DRIVE WHEEL REPLACEMENT

1. Remove the rubber drive belt just below the drive wheel.
2. Loosen the two 3 x 6 Allen head set screws (between the drive wheel and the pulley). See Fig. 5-12. A 1.5 mm hex key is required. Back the screws out quite far to clear the shoulder on the shaft.
3. Pull the drive pulley down from beneath the chassis to free the Drive Wheel. Be careful not to misplace a nylon washer beneath the drive wheel.

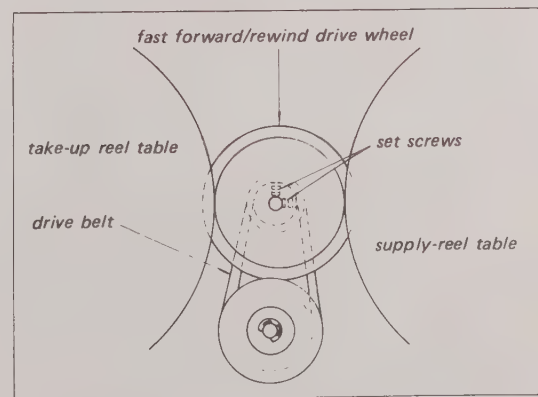


Fig. 5-12. Drive wheel replacement

4. Work out the Drive Wheel from the front of the machine.
5. Replace the Drive Wheel and belt by reversing the above procedure. Set the Drive Wheel for a 0.1 mm vertical play on the drive shaft.
6. Check REW and FF Torque. See Section 5-13.

5-11. THREADING RING DRIVE WHEEL REPLACEMENT

1. Retract the Threading Ring Drive Pulley Lever with your fingers or a retraction jig (3-702-222-01).
2. Loosen the 3 × 3 set screw (1.5 mm Allen Key) and pull off the Threading Ring Drive Wheel.
3. Replace the drive wheel and set for 0.1 mm vertical play in the drive wheel shaft.

5-12. REEL TABLE REPLACEMENT

Reel tables require replacement if noise or vibration is evident due to the limiter or clutch springs (See Fig. 5-13 (a).) or if the torque of the Reel Tables is nonuniform. Remove the cassette loading compartment first and then, replace the Reel Tables as follows:

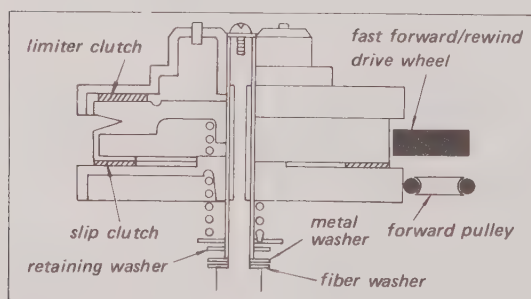


Fig. 5-11 (a). Cross section of take-up reel table

Supply Reel Table

1. Remove the B3×6 screw (black) at the shaft of the Reel Table.
2. Move the Brake Chassis Assembly clockwise (See Fig. 5-13 (b).) and pull up the Reel Table. Be careful not to misplace a fiber washer (if used) beneath the Reel Table.
3. Wipe out the shaft hole in the replacement Reel Table and apply a drop of SONY OL-1K oil to the inner surface.

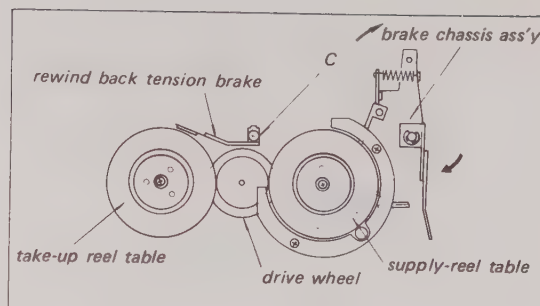


Fig. 5-13 (b). Reel table replacement

4. Move the Brake Chassis Assembly to the right to provide as much slack as possible on the Brake Band. Install the Reel Table. Be careful not to bend the Threading Back Tension Assembly underneath the Reel Table.
5. Check the height of the Reel Table using the gauge shown in Fig. 5-14 (Part No. 3-702-207-01). If height is incorrect, add or subtract fiber washers (5 mm dia, 0.3 mm thickness) and metal washers (5 mm dia, 0.1 mm).

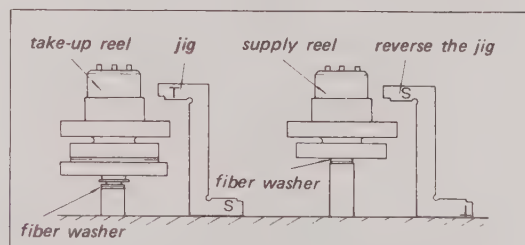


Fig. 5-14. Use of the jig to check reel table height

6. Install the B3 × 6 screw and washer and check for vertical play in the assembly. There should be perceptible vertical play left.
7. Check back tension as direction in Section 5-15.

Take-up Reel Table

1. Remove the B3 × 6 screw (black) at the shaft of the Reel Table.
2. Remove screw C in Fig. 5-13 (b) and remove the Rewind Back Tension Brake Assembly.
3. Remove the Counter Belt from the Counter Pulley.
4. Remove the Drive Wheel as described in Section 5-10, and then pull up the Reel Table. Be careful not to misplace the fiber washer (if used) beneath the Reel Table.

5. Wipe out the shaft hole of the replacement table and apply a drop of SONY OL-1K oil to the inner surface. Place the counter drive belt on the new reel table.
6. Place the Take-Up Reel Assembly on the shaft. Push the Drive Wheel to the right to lower the table into place.
7. Check the height of the Reel Table above the chassis using the jig shown in Fig. 5-14. Add or subtract fiber washers (6 mm dia, 0.3 mm thickness) to correct the height.
8. Install the B3 x 6 screw and washer. Check for a perceptible vertical play on the shaft (It should not be perfectly tight.).
9. Replace the Rewind Back Tension Brake Assembly and position the counter drive belt on the counter pulley.
10. Adjust back tension as directed in Section 5-15.

5-13. DRIVE TORQUE CHECKS

Drive torque should be checked whenever the Reel Tables or Drive Wheel is replaced.

Rewind Drive Torque

1. Place the Back Tension Adjustment jig over both Reel Tables (Part No. 3-702-216-01). See Fig. 5-15 (a).
2. Place a dummy reel pack (100 mm dia, Part No. 3-702-215-01) on the Supply Reel Table.

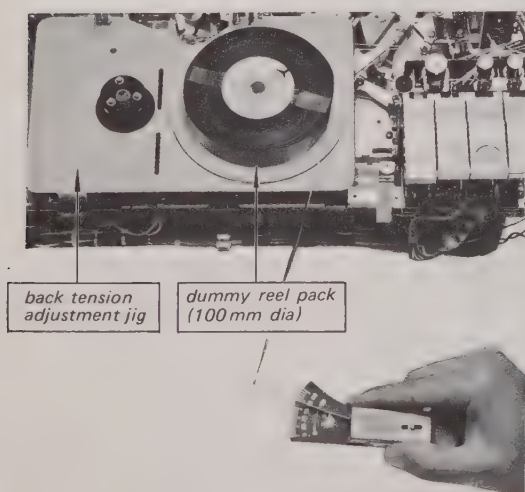


Fig. 5-15 (a). Drive torque check setup

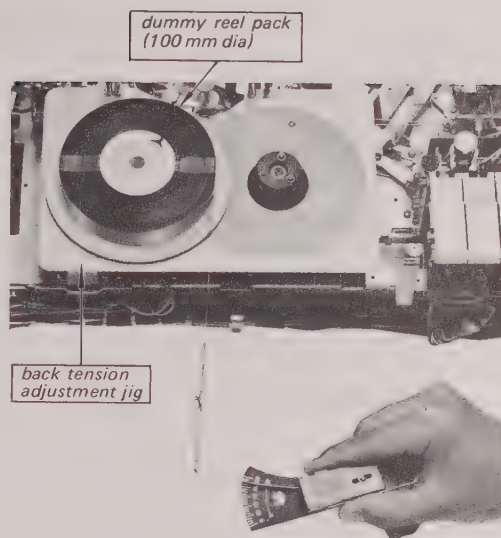


Fig. 5-15 (b). Drive torque check setup

3. Attach a spring scale to the end of the tape and hold the scale as shown in Fig. 5-15 (a).
4. Press the REWIND button and hold the tape so that the clutch slips. The scale reading should be 200 to 340 grams for a torque of 1 to 1.7 kg-cm.
5. Stall the Reel Table by hand and check to see that the mechanical limiter is functioning.

FF Torque Check

1. Depress the FF button.
2. Hold the Take-Up Reel Table by hand to check to see if the mechanical limiter is working (Reel table slips at the limiter only.).
3. Stop the machine and set the Back Tension Adjustment jig in place on both reels.
4. Place a dummy reel pack with a 100 mm diameter on the Take-Up Reel Table. Hold the end at the spring scale as shown in Fig. 5-15 (b).
5. Press the FF button.
6. Measure torque while the table is slipping at the limiter. The correct reading is 200 to 340 grams (1.0 to 1.7 kg-cm).

FWD Drive Torque Check

1. Cover the photo transistor with a black pen cap.
2. Press the PLAY button and grasp the Take-Up Reel Table by hand to make sure that the Table slips at the limiter.

3. Stop the machine and place the Back Tension Adjustment Jig (Part No. 3-702-216-01) over both reel tables. Place a dummy reel pack (100 mm dia; Part No. 3-702-215-01) on the Take-Up Reel Table. Hold the end of the tape with the spring scale. See Fig. 5-15 (b).
4. Press the Play button and move the tape end to simulate a tape speed of 3-3/4 i.p.s. The scale measurement should be between 84 and 104 grams. (420 to 520 g-cm). For out of tolerance readings, replace the reel table. If the drive surfaces slip rather than the limiter, or clutch, check the drive surfaces and pressures.

5-14. STOP BRAKE ADJUSTMENTS

Brake torque should be checked when the Sub Chassis, the Brake Chassis Assembly or the Supply Reel Tables are replaced or serviced.

1. Check to see that the brake pad is tangent to the Supply Reel Table. See Fig. 5-16. Bend the Brake Lever at point A if necessary.
2. Check to see that the right edge of the Brake Chassis Assembly is at right angles to the rear edge of the Subchassis. See Fig. 5-16. Bend the stopper B to make it so.
3. Push the STOP button and place a dummy reel pack (100 mm dia; Part No. 3-702-215-01) on the Supply Reel Table. Measure torque in both clockwise and counterclockwise directions.

clockwise - 200 g to start slipping
counterclockwise - less than 100 g to start slipping
If brake is off limits in the clockwise direction, adjust the Spring Anchor marked C in Fig. 5-16.

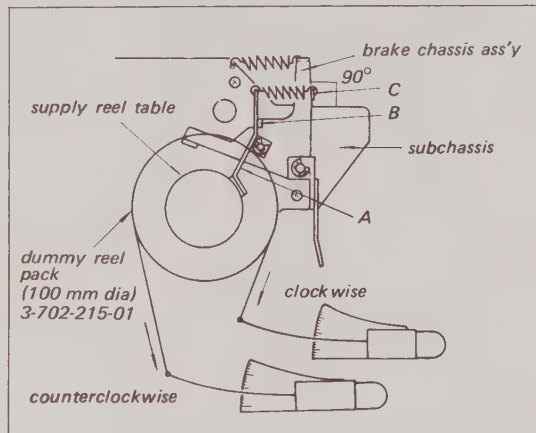


Fig. 5-16. Stop brake adjustment

5-15. TENSION REGULATOR ADJUSTMENTS

Remove the cassette loading compartment first, and then perform the following adjustments.

Adjustment of Tension Arm S

(Refer to Fig. 5-17 and 5-18)

1. Place the Tension Arm Position Jig (Part No. 3-702-224-01) on both Reel Tables.

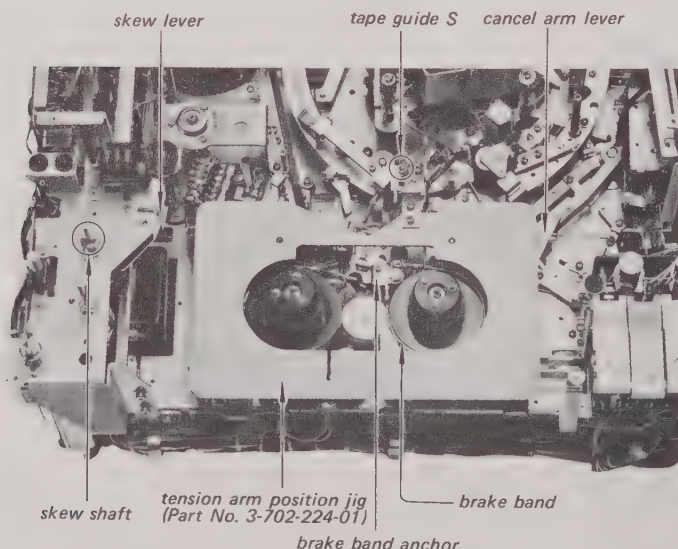


Fig. 5-17 (a). Setup for checking the back tension regulator

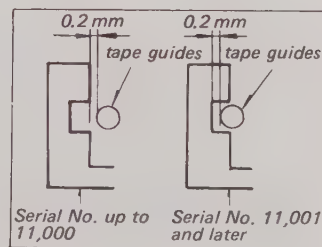


Fig. 5-17 (b). Brake band anchor adjustment

2. Set the SKEW control to midrange.
3. Depress the PLAY button.
4. Turn the Supply Reel Table clockwise slowly by hand.
5. Adjust the position of the Brake Band Anchor (loosen the mounting screw) for 0.2 mm clearance between the bracket on the jig and Tape Guide S. See Fig. 5-17 (b).
6. Set SKEW fully clockwise. Remove the jig.
7. Press the PLAY button and check for 0.2 to 1.0 mm clearance between Tension Arm S and the pin in the linkage of the Arm Cancel Lever. See Fig. 5-18. Adjust the tang of the Arm Cancel Lever to the left or right to obtain the correct clearance.
8. Press the Stop button and check for 1.5 to 2.5 mm clearance between Tension Arm S and the Cassette Opener Plate. Readjust the tang of the Tension Arm Cancel Lever if necessary.

Tension Arm Height Adjustment

1. Check for perpendicularity and height of Tension Arm S with the jig (Part No. 3-702-206-01). Place the short base of the jig against the main chassis to the left of the Capstan Bearing as shown in Fig. 5-19.
2. Bend Tension Arm S with the bending jig (Part No. 3-702-203-01) to secure proper alignment.
3. To check for perpendicularity and height at Tension Arm T, reverse the jig as shown in Fig. 5-19. Remove one mounting screw from the Guide Rail to make room for the jig.
4. Bend Tension Arm T with the bending jig (Part No. 3-702-204-01) to secure the correct setting.
5. Replace the screw in the Guide Rail when adjustment is complete.

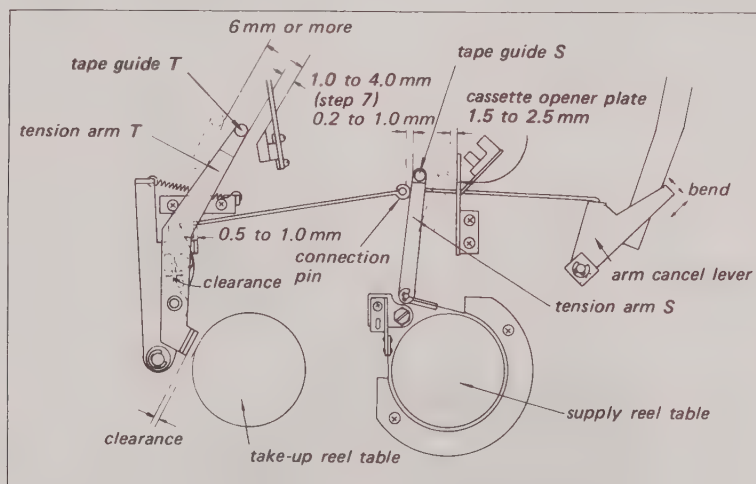


Fig. 5-18. Tension regulator adjustment

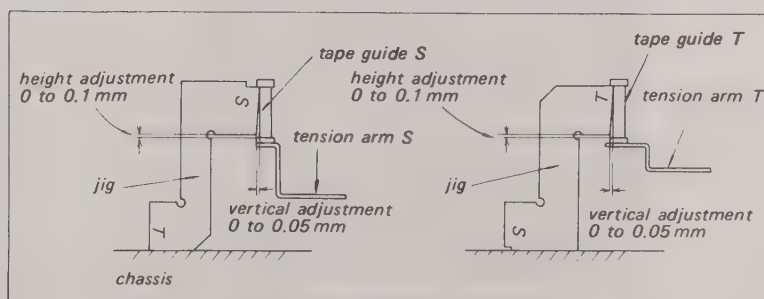


Fig. 5-19. Tension arm adjustment

Rewind Back Tension Adjustment

1. Remove the Counter Belt from the Counter Pulley.

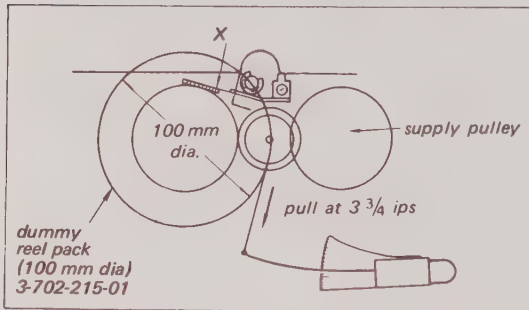


Fig. 5-20. Rewind back tension check

2. Place a dummy reel pack (100 mm dia; Part No. 3-702-251-01) on the Take-Up Reel Table.
3. Press the REWIND button.
4. Using a spring scale at the tape end, pull the tape at approximately 3-3/4 inches per second.
5. The reading on the spring scale should be 8-10 grams. See Fig. 5-20.

6. Bend the REW Back Tension Bracket at X in Fig. 5-20 to secure the correct reading.
7. Check for clearance between the REW Back Tension Brake and the Take-Up Reel Table in the Stop mode.
8. Replace the counter belt.

Threading Back Tension

1. Place the Back Tension Adjustment Jig (Part No. VA-0058) over both Reel Tables and place a dummy reel pack (100 mm dia; Part No. 3-702-215-01) on the Supply Reel Table.
2. Remove the screws at the top edge of the C-R board and swing the top of the board out and down.

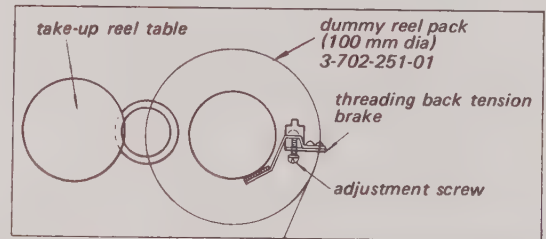


Fig. 5-21. Check for threading back tension

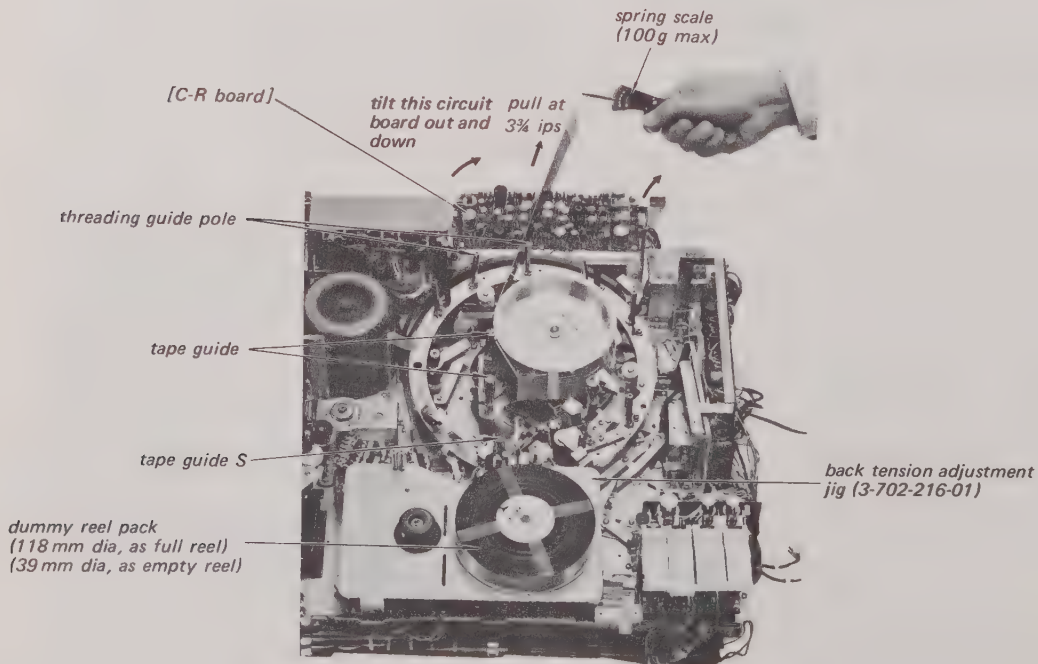


Fig. 5-22. Tension regulator back tension check setup

3. Press the FF button and measure threading back tension while pulling the tape end at $3\frac{3}{4}$ i.p.s. as shown in Fig. 5-22.
4. Adjust the screw on the Threading Back Tension Brake Assembly (See Fig. 5-21) for a reading of 8-9 grams. This screw is on the right-hand brake assembly beneath the Supply Reel Table.

Forward Back Tension Adjustment

Note: Place a black pen cap on the photo transistor.

Threading Back Tension should be set first.

Swing down the top edge of the C-R board for room to pull the tape.

1. Place the Back Tension Adjustment Jig (Part No. 3-702-216-01) on both Reel Tables and place a dummy reel pack (118 mm dia; Part No. 3-702-214-01) on the Supply Reel Table.
2. Set SKEW to mid range (pin opposite the mark on the cam). Press the PLAY button. Pull the tape end with a spring scale as shown in Fig. 5-22 at about $3\frac{3}{4}$ i.p.s. Pull the tape between the guide on the jig and the Tape Guide. Proper reading is 70–75 grams.
3. Bend the tang of the Skew Lever for the correct reading. See Fig. 5-23.
4. Stop the machine and place a dummy reel pack (39 mm dia; Part No. 3-702-213-01) on the Supply Reel Table and repeat Step 2. The tension reading should be 90–95 grams. If the reading is out of tolerance recheck with a 118 mm diameter reel pack.

CAUTION

Check to make sure that the Tension Arm does not obstruct illumination of the photo transistor at any setting of the SKEW control. (Auto Stop should be initiated if the black pen cap is removed from the photo transistor.)

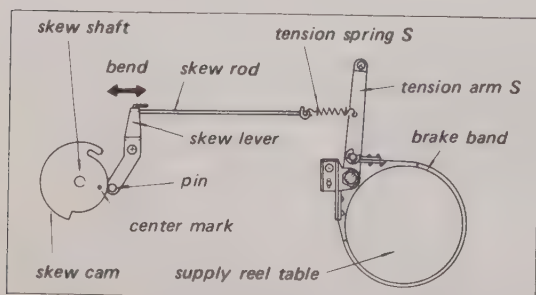


Fig. 5-23. Setup for forward back tension check

5-16. FUNCTION BUTTON/RECORD-FUNCTION BUTTON ASSEMBLY REPLACEMENT AND ADJUSTMENT

Function Button Assembly Replacement

1. Unsolder nine leads on the Q board as shown in Fig. 5-24.
2. Remove the four PS 3x6 screws to remove the function button assembly together with record button assembly. See Fig. 5-25. Care should be taken when removing the function assembly, as the front horizontal members of the function button assembly are engaged with threading link lever and leaf spring tang of brake chassis as shown in Fig. 5-26.

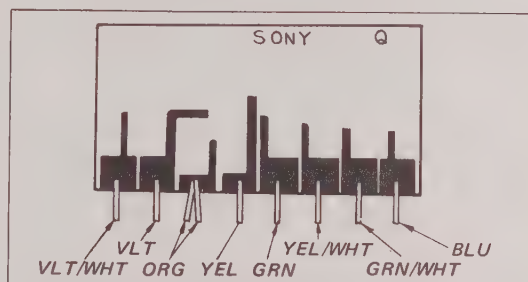


Fig. 5-24. Wiring on Q board

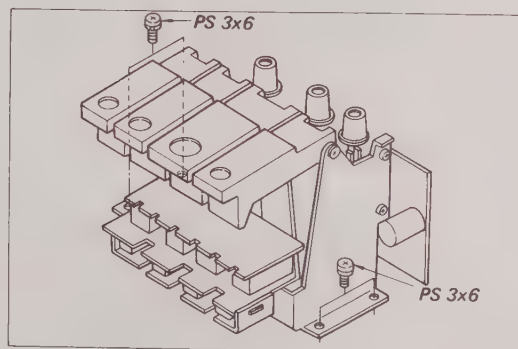


Fig. 5-25. Function button assembly removal

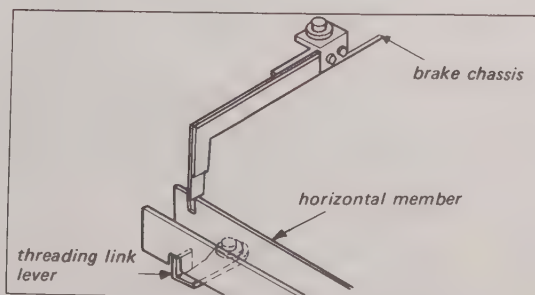


Fig. 5-26. Detail of linkage

3. Remove the four PS 3x5 securing the record function button assembly to the bracket of function button assembly as shown in Fig. 5-27.
4. Remove the lock arm plate on the slide plate of PLAY button (See Fig. 5-28), and then fix it to the new function button assembly.
5. Replace the record button assembly and the function button assembly by reversing the foregoing steps.

After completing the replacement of function button or record function button assembly, check as follows:

Note: Make sure that threading link lever and leaf spring tang of brake chassis are in the notch on the front horizontal member of the function button assembly as shown in Fig. 5-26.

Place the lower tang of FF button lever in front of the fast forward lever as shown in Fig. 5-29.

Follow replacement check for proper latching action and operation of all function buttons as described later.

Record-Function Button Assembly Replacement

1. Remove the function button assembly together with record function button assembly as described in function button assembly replacement. See Fig. 5-25.

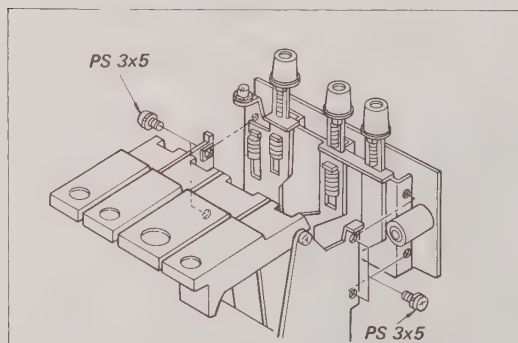


Fig. 5-27. Record-function button assembly removal

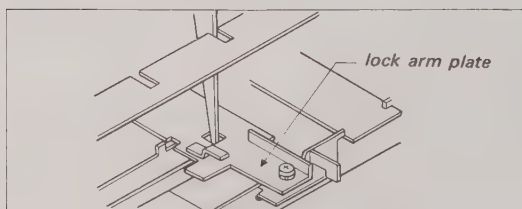


Fig. 5-28. Lock arm plate removal

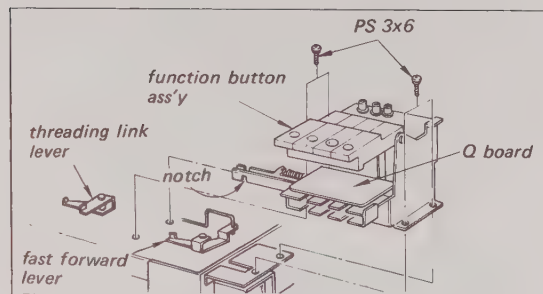


Fig. 5-29. Installation of the function button assembly

2. Remove the four PS 3x5 screws securing the record function button assembly to the function button assembly bracket as shown in Fig. 5-27. This frees record function button assembly.
3. Remove the three PS 3x5 screws securing R board to the record function button bracket, and then replace it to the new record function button assembly. See Fig. 5-27.
4. Replace the function button assembly and the record function button assembly by reversing the foregoing steps.

Function Button Operational Check and Adjustments

1. Press the F. FWD, PLAY, REWIND buttons and check for proper latching.
2. Check for 0.05 to 0.5 mm clearance between the Fast Forward Arm and the stopper on the Drive Wheel Lever in F. FWD mode. See Fig. 5-30.
3. Bend the end of the Fast Forward Lever at F to secure the correct clearance.
4. Stop the Take-Up Reel Table by hand and check that the Take-Up Reel Table slips at the limiter smoothly. If the Limiter does not work smoothly even if the correct clearance is obtained in Step 2, there is a lack of drive pressure. Check for possible causes of insufficient pressure. For example, the end of Solenoid Link Plate B might be striking the Bracket that supports the phototransistor (Refer to Fig. 5-38 for location of Solenoid Link Plate B.).
5. Check for 0.5 to 2.0 mm clearance between the circular drive belt and the Take-Up Reel Table. To correct this clearance, bend the vertical member of the FWD Release Lever to the left or right. See Fig. 5-30.

6. Press STOP and then REWIND buttons.
7. Stop the Supply Reel Table by hand and check to see that the limiter on the Supply-Reel Table works smoothly.
8. Check to see that in PLAY mode, RECORD and AUDIO DUB buttons cannot be depressed but only AUDIO DUB button is latched after depressing AUDIO SAFETY button.
9. In RECORD mode, check to see that SKEW

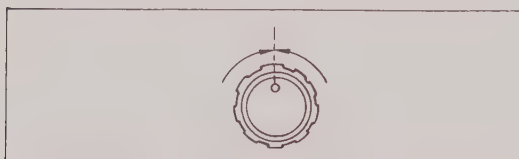


Fig. 5-31. Skew control knob operation

control knob comes to its center position (neutral) automatically. See Fig. 5-31.

5-17. DC DRIVE MOTOR REPLACEMENT

1. Remove the two PS3x6 screws from the top and the three PS3x6 screws from the bottom that secure the F board ass'y and its shield cover and remove the modulator as shown in Fig. 5-33.
2. Unsolder the two leads from System Control on the M Board (mounted on the motor).
3. Remove the two PS3 x 6 screws that secure the motor assembly to the chassis. Remove the circular drive belt from the motor pulley.
4. Replace the motor by reversing the foregoing steps.

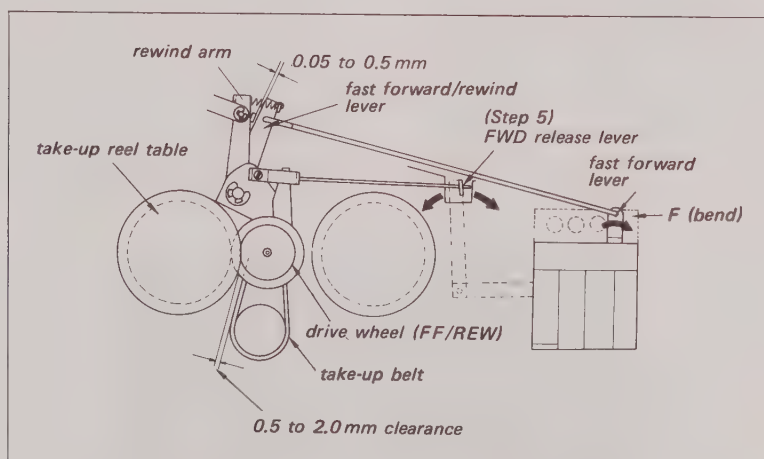


Fig. 5-30. Function button adjustment

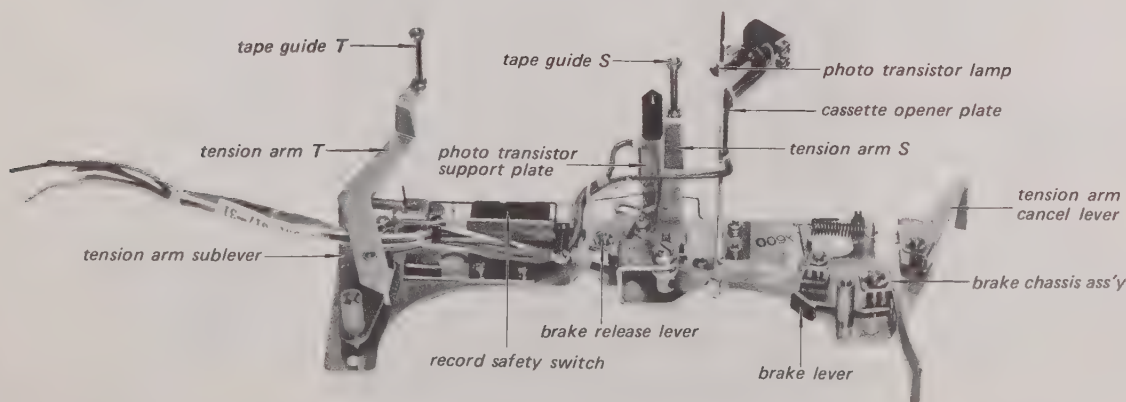


Fig. 5-32. Subchassis removal

5-18. SUBCHASSIS (MECHANICAL) DISASSEMBLY

The subchassis is mounted just behind and below the Reel Tables.

1. Remove the two PS3 x 6 screws and lift off the Brake Band Stopper (semicircular aluminum ring surrounding the Supply Reel Table).
2. Unhook the spring on the Tension Arm S (Linked to the SKEW control). Be careful not to stretch the spring.
3. Remove the retaining washers (E washers) from both ends of the Threading Ring Lock Release Rod (long rod linked to Solenoid A). Be careful not to lose the E washers. Remove the rod.
4. Remove the five black screws that hold the Subchassis.
5. Release the lock on the Threading Ring and rotate the Threading Ring by hand to move the Threading Guide Roller away from the Subchassis.
6. Unsolder the leads to the photo transistor and lamp at the terminal strip mounted on the Solenoid B.

7. Rotate the Brake Plate counterclockwise (See Fig. 5-32). Lift off the Subchassis.
8. Reverse the above procedure to replace the Subchassis and make the following adjustments.

SECTION

Tension Arm position and height	(5-15)
Tension Regulator	(5-15)
Brake	(5-14)
Function Button Latch	(5-16)

In addition, check for proper operation of the Auto Stop system.

5-19. THREADING RING REPLACEMENT

If the guides on the Threading Ring have been bent or misaligned so that tape runs off or fouls during the threading or unthreading operations, it might be necessary to replace the Threading Ring.

1. Retract the Threading Ring Drive Pulley Lever with your fingers or a retraction jig (3-702-222-01).
2. Release the lock on the Threading Ring and rotate the ring by hand until the hole marked with an X in Fig. 5-33 is in front of the capstan shaft. Do not push on the guides. Use the point of a Phillips head screwdriver in the hole in the ring.

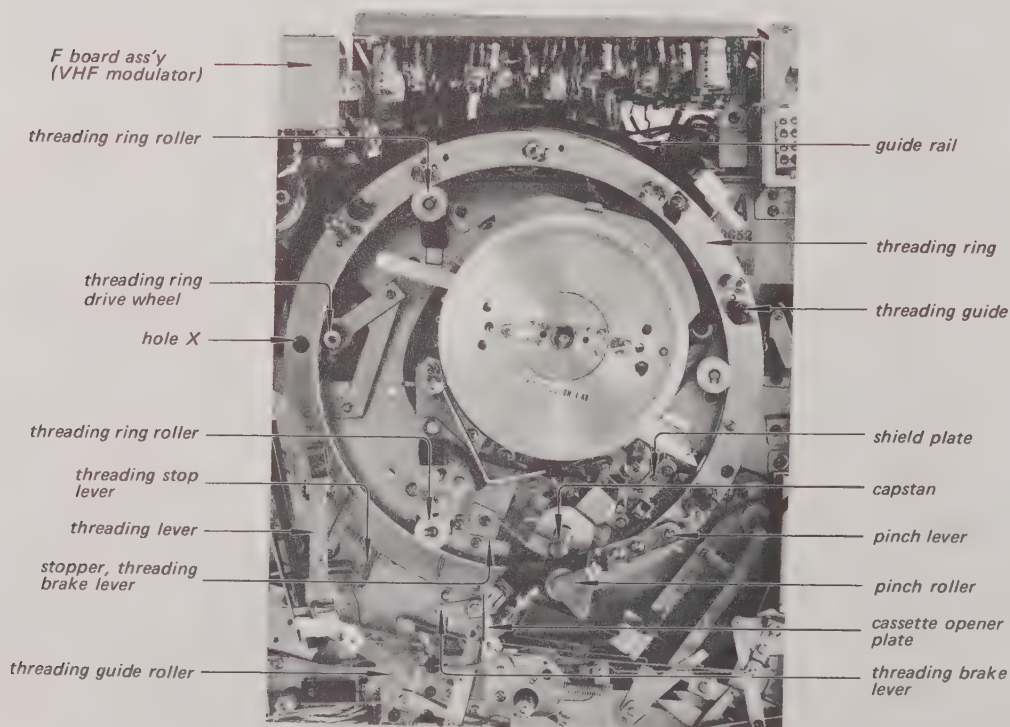


Fig. 5-33. Threading ring replacement

3. Remove the two screws that secure the rear Threading Ring Roller Bracket to the chassis.
4. Lift out and replace the Threading Ring by reversing this procedure. Be careful not to touch the Head-Drum Assembly.
5. Put a 0.2 mm shim between the Threading Ring and the rear ring roller. Tighten the mounting screws of the support bracket for this roller by holding the roller tight against the shim.
6. Check to see that the ring rotates freely after the shim has been removed.
7. Check for Threading Ring operation and proper operation of the three microswitches.

5-20. SOLENOID REPLACEMENT

Dust and dirt in the solenoid may impair its pulling power. In case of faulty operation, try removing and cleaning the plunger. If trouble persists replace the solenoid.

Solenoid A (FWD)

1. Remove the two P3 x 8 screws at the top edge of the B-R board and swing the board down.
2. Unsolder the leads at the terminals of the solenoid.
3. Remove the E washers shown in Fig. 5-34 and unhook springs A and B.
4. Back screw C all the way out to remove the Spring Adjustment Plate.
5. Remove the four PS 3x6 screws securing the solenoid bracket at the chassis and lift out the entire bracket-solenoid assembly.
6. Check the replacement solenoid for proper mechanical operation and install it by reversing the foregoing procedure.

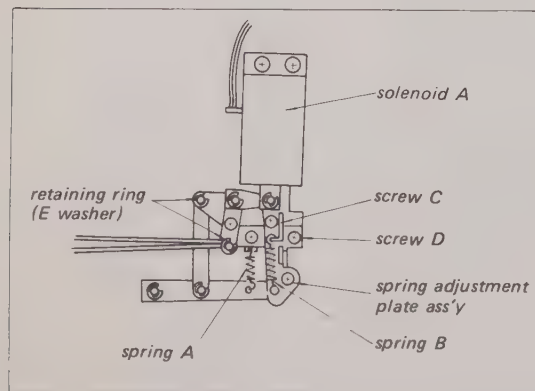


Fig. 5-34. Removal of solenoid A

The following checks must be made after the solenoid has been replaced.

7. Press the PLAY button.
8. Refer to Fig. 5-35. Loosen the solenoid mounting screws and position the solenoid carefully back and forth so that the tip of the Eccentric Roller Arm (2) is latched by the Eccentric Arm Lock Lever, and that the tip of the Eccentric Roller Arm (2) is within 0.5 mm of the line scribed on the lock lever. Confirm that mechanical shock does not release latching.

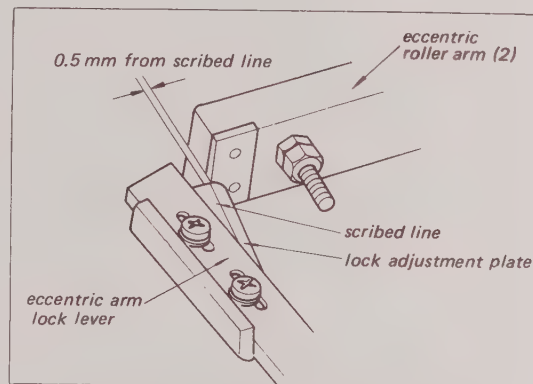


Fig. 5-35. Solenoid A adjustment

9. Refer to Fig. 5-36. Check the clearance between the post on the Eccentric Arm Lock Release lever and the hole in the Spring Adjustment Plate. The clearance should be 1.5 to 2.0 mm. Adjust the clearance by loosening the screw in the Spring Adjustment Plate.
10. Hold the Plunger of Solenoid A with your fingers, and then turn off the power switch. Confirm that mechanical lock is released when you frees the plunger.
11. Following Step 9, recheck Step 8 and make sure that the Pinch Roller Pressure Spring is operating (Eccentric Roller Arm (2) is clear of the double nuts by 0.5 to 1 mm.
12. Press the STOP button.
13. Refer to Fig. 5-37. Make sure that Eccentric Roller Arm (2) is stopped against the end of the Eccentric-Roller Arm Support Lever. The clearance between the Support Lever and the Lock Lever should be 0.2 to 1.0 mm. Adjust the position and angle of the Support Lever Stopper for the proper clearance.

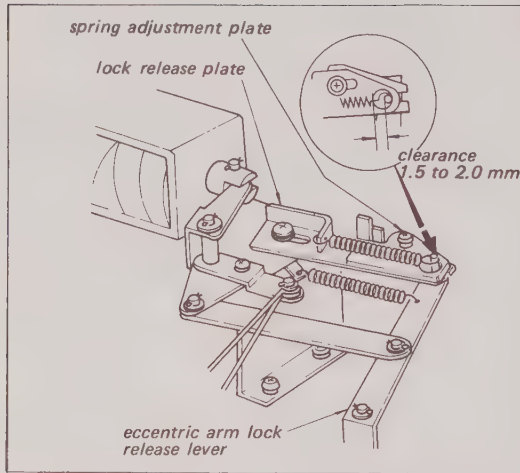


Fig. 5-36. Solenoid linkage adjustment

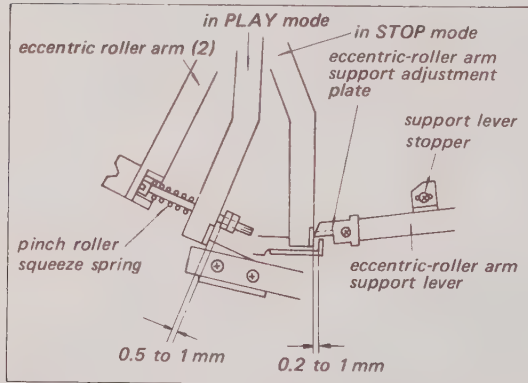


Fig. 5-37. Solenoid A linkage adjustment continued

14. Check to see that the brake is released on the Supply Reel Table in the Play Mode. See Fig. 5-38. The brake pad should clear the Supply Reel Table by 0.4 to 0.8 mm. To correct this reading, adjust the Solenoid Lever Adjustment Plate.
15. Check to see that the latch is released from the threading ring. If the latch does not release, bend the Lock Release Rod.
16. Check to see that the Function button latch mechanism works properly.
Check to see that the part of the Brake Chassis Ass'y marked with an X in Fig. 5-38 is pulling the Function Button Lock Plate all the way to the left. If it does not, bend that part of the Brake Chassis Ass'y marked with an X.

Solenoid B (REW)

1. To remove the solenoid, unhook the spring to Tension Arm T and rotate the Tension Arm Support Plate counterclockwise as far as it will go. Refer to Fig. 5-39.
2. Unsolder the leads at the solenoid terminals.
3. Remove the two screws that hold down the U Board on Solenoid B. Swing the board out of the way.
4. Remove screw A, PS 3x6, in Solenoid Link Plate B and the retaining ring (B).
5. Unhook the Threading Lock Spring at the anchor under one of the solenoid mounting screws. See Fig. 5-39.

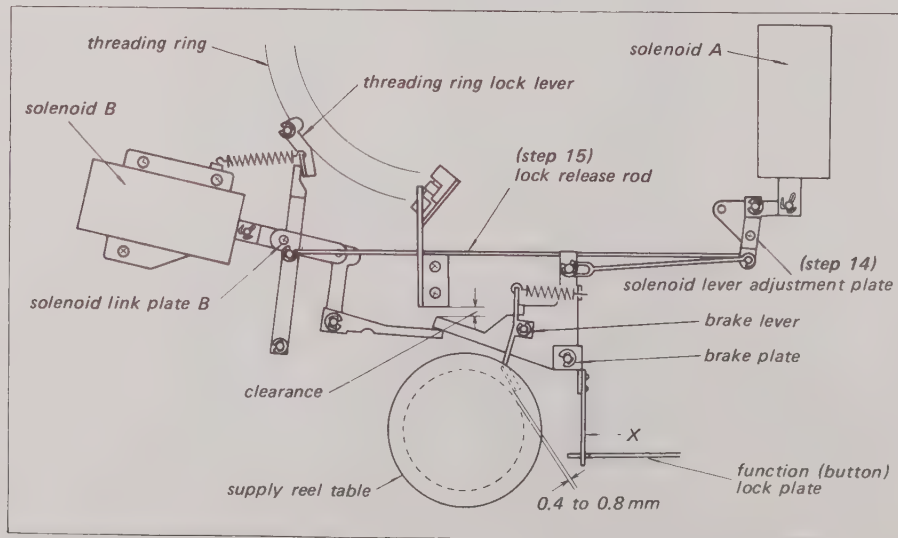


Fig. 5-38. Play mode solenoid linkage adjustment

6. Remove the three screws D that secure the solenoid to the chassis. Lift out the solenoid.
7. To replace the solenoid reverse the foregoing steps but leave the mounting screws loose for the following adjustments.
8. Tighten the screws temporarily so that the plunger operates in line with Solenoid Link Plate C. See Fig. 5-39.
9. Press the REWIND button.
10. Position the solenoid so that the clearance between the Rewind Arm and the Stopper on the Drive Wheel lever is 1.0 to 1.5 mm. See Fig. 5-40.
11. Check for clearance between the Take-Up Belt and the Take-Up Reel Table.
12. Adjust the position of Solenoid Link Plate B (Fig. 5-39) so that the clearance between the Brake Chassis Ass'y and the bottom of the Cassette Opener is the same as it is in the PLAY mode. Tighten the screw in Solenoid Link Plate B.
13. Check to see that the Drive Wheel (FF/REW) Assembly goes from the Supply Reel Table to the Take-Up Reel Table smoothly when going from REWIND to STOP. If not adjust the linkage between the solenoid and Link Plate B.

5-21. THREADING ADJUSTMENTS

Threading adjustments are required when the Threading Ring is replaced, or if the threading microswitches are replaced.

1. Place the Back Tension Jig (Part No. 3-702-216-01) over both Reel Tables. Check to see that the Threading Guide Roller is centered from side to side in the notch of the jig. If it is not, reposition the Guide Rail.
2. Rotate the Threading Ring by hand slowly to the stop position. Check to see that the Threading Guide Roller is within the dimensions (X) shown in Fig. 5-41.
3. If the Threading Guide Roller is not positioned as indicated in Step 2, loosen the screw in the Threading Ring Lock Lever Base. See Fig. 5-42. Bend the vertical tab on the Threading Switch Lever (marked XX in Fig. 5-42) to position the Threading Guide Roller properly. Check to make sure that the Front Horizontal Member is fully to the right in the Function Button Assembly when making this adjustment.
4. Reset the Threading Ring Lock Lever Base so that the roller is in the notch on the Threading Ring and tighten the screw.
5. Check for actuation of the end-of-unthreading microswitch S6011 when moving the Threading Ring to the stop position by hand.
6. If the switch does not operate properly, adjust the position of the micro switch or bend the actuator to provide 0 to 0.3 mm clearance at the gap marked A in Fig. 5-42.
7. Hold the Rubber Threading Drive Wheel away from the Threading Ring with your fingers and rotate the Threading Ring slowly by hand. Check the following.

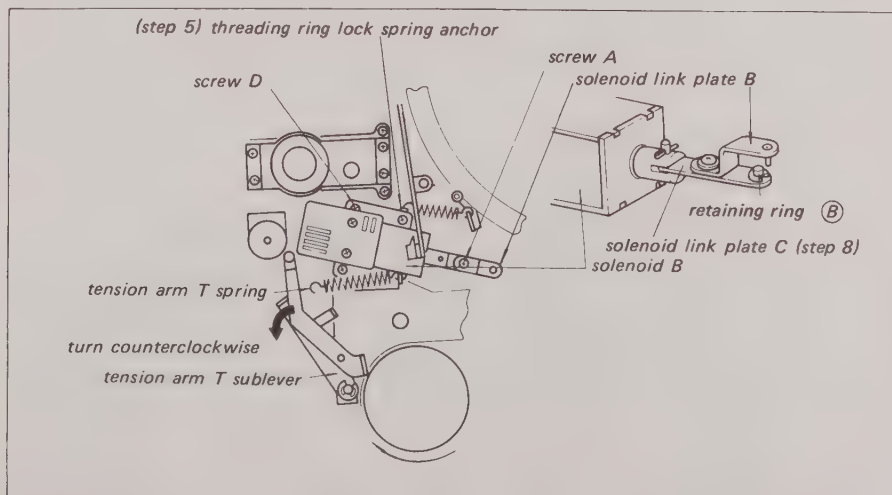


Fig. 5-39. Solenoid B removal

- (a) The Threading Ring should turn smoothly.
- (b) The Pinch Roller should not touch the Guide Rail.
- (c) The Threading Lever should run smoothly on the Guide Rail.
- (d) The ac motor turns on as the Pinch Roller passes the ac motor microswitch.
- (e) The actuator for the ac motor switch does not touch the Threading Ring except for the cam mounted beneath the ring.

Reposition the rear threading roller bracket, the ac motor switch or the Guide Rail to

correct any disagreement with the preceding.

- 8. Refer to Fig. 5-43. Rotate the Threading Ring to the fully threaded position and adjust the position of the Threading Stopper so that the pin beneath the Threading Ring runs fully off the cam of the Threading Brake Lever and check for separation between the Threading Brake Pad and the Supply Reel Table.
- 9. Check for actuation of the end-of-cycle microswitch S6010 when the Threading Ring is in the fully-threaded position. If not, reposition the microswitch or bend the actuator.

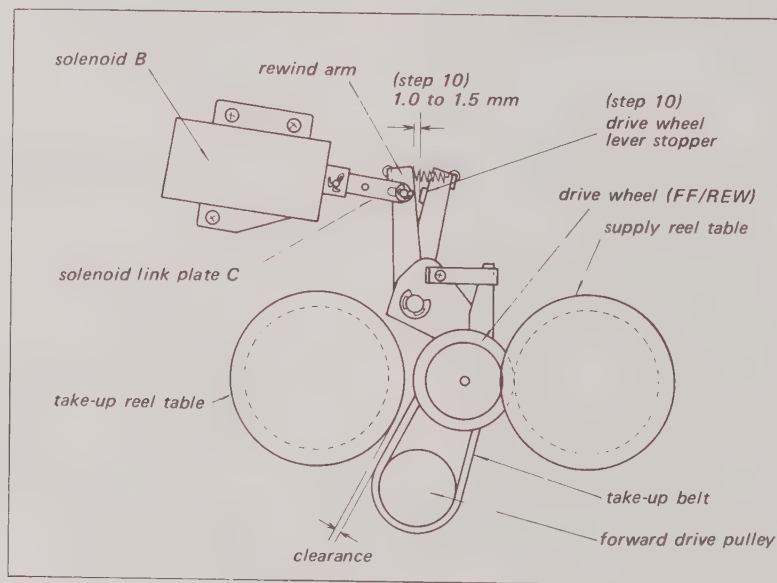


Fig. 5-40. Rewind solenoid adjustment

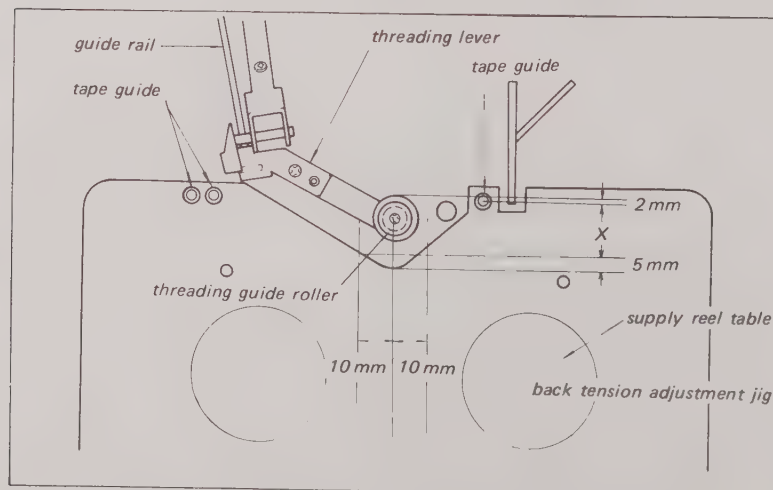


Fig. 5-41. Adjustment of threading guide roller position

10. Check for 0 to 0.3 mm clearance between the Threading Switch Lock Lever and Eccentric Roller Arm 2. If necessary to correct, bend the Threading Switch Lock Lever at the point marked XXX in Fig. 5-43.
11. Bend the Eccentric Roller Brake Lever (marked XXXX) for a small amount of clearance between the Eccentric Roller Brake and the Eccentric Roller. See Fig. 5-43.
12. Check for proper position of the Pinch Roller when the threading cycle is complete. Refer to Section 5-9.
13. Return the Threading Ring to the STOP position.

Threading Brake Adjustment

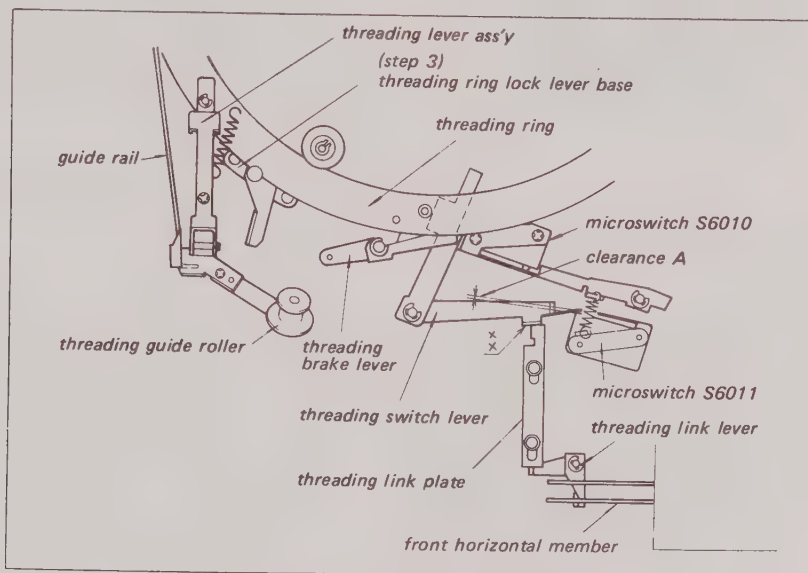


Fig. 5-42. Threading adjustments

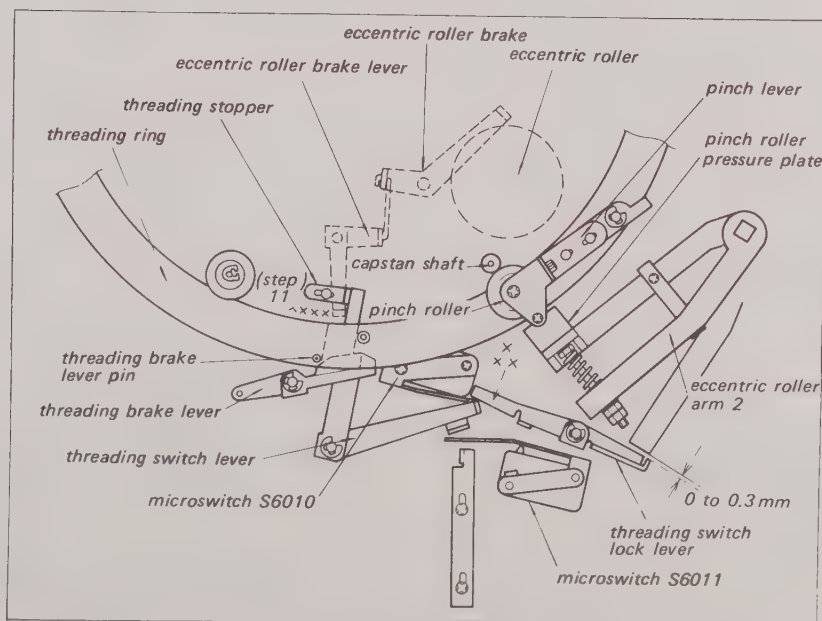


Fig. 5-43. Threading adjustments at the fully threaded position

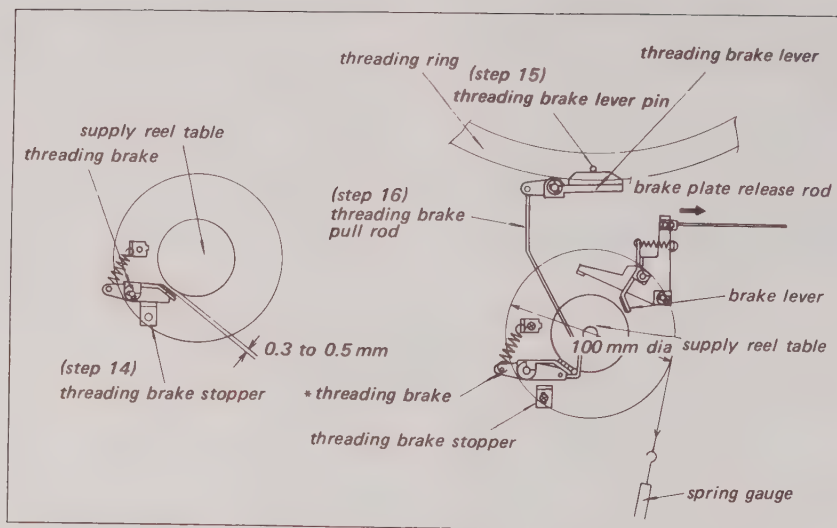


Fig. 5-44. Threading brake adjustments

14. Refer to Fig. 5-44. Check for 0.3 to 0.5 mm clearance between the Threading Brake and the Supply Reel Table. Adjust the Threading Brake Stopper if necessary.
15. Rotate the Threading Ring by hand until the pin beneath the ring (near the Threading Guide Roller in the fully threaded position) rides in the center of the cam on the Threading Brake Lever. See Fig. 5-44.
16. Place a dummy reel pack (100 mm dia; Part No. 3-702-215-01) on the Supply-Reel Table. Cancel the Brake Lever by hand and test the hold back of the Threading Brake. The reading should be 100 – 120 grams (400 to 600 gram-cm).
If out of limits, remove the Supply Reel Table and bend the Threading Brake Pull Rod.

6. Pull out the Capstan Shaft from the top and replace the shaft and/or bearing. See Fig. 5-47.
7. Install the Eccentric Roller Sleeve and set for minimum vertical play in the shaft.

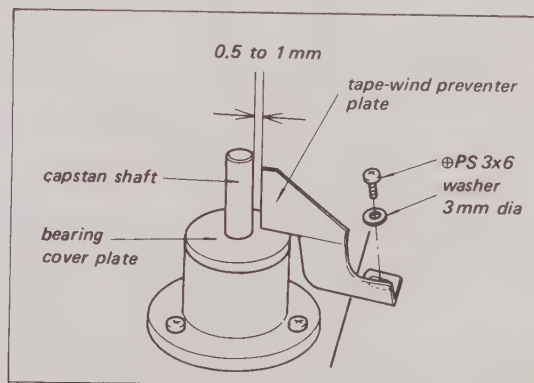


Fig. 5-45. Capstan disassembly

5-22. CAPSTAN SHAFT AND BEARING REPLACEMENT

1. Remove the diagonal chassis brace beneath the chassis.
2. Remove the PS3 x 6 screw that secures the Tape-Wind Preventer Plate. See Fig. 5-45.
3. Pull off the Bearing Cover Plate.
4. Loosen the two 4 x 4 set screws in the Flywheel and remove the Flywheel.
5. Loosen the two 3 x 3 set screws to remove the Sleeve that drives the Eccentric Roller. See Fig. 5-46.

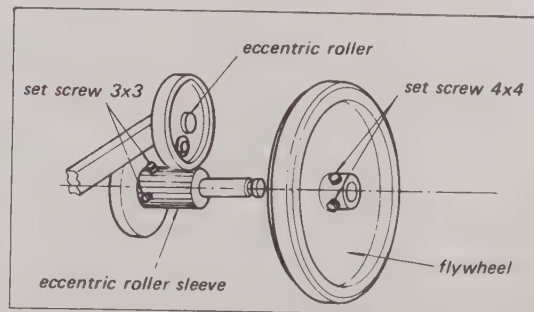


Fig. 5-46. Flywheel/eccentric roller sleeve assembly

8. Install the Flywheel against the Eccentric Roller Sleeve.
9. Replace the Bearing Cover and the Tape-Wind Preventer Plate. Adjust for 0.5 to 1 mm clearance between the plate and the capstan.

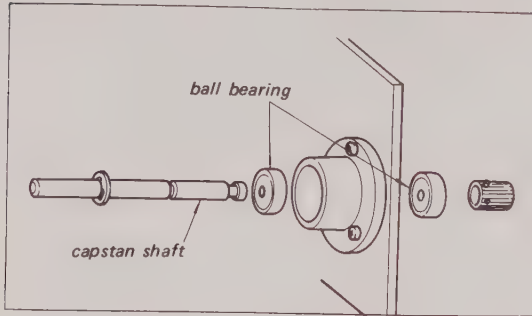


Fig. 5-47. Capstan bearings

5-23. DRIVE BELT REPLACEMENT

There are ten rubber drive belts as follows:

Name	Part No.	Width (mm)	Diameter (mm)
1. Drum Belt	3-630-536-01	8	151.7
2. Motor Belt	3-630-537-01	10	84.8
3. Capstan Belt	3-630-545-01	12	175.7
4. Drive Belt	3-630-538-01	4 (round)	183.0
5. Take-Up Belt	3-630-501-01	3 (round)	375
6. Threading belt 1	3-630-699-01	3 (round)	34.1
7. Threading belt 2	3-630-458-02	3 (round)	55.1
8. Counter Belt 1	3-630-580-01	1.6 (round)	56.7
9. Counter Belt 2	3-630-581-01	1.6 (round)	107.8
10. Counter Belt 3	3-630-582-01	1.6 (round)	36.0

Refer to Fig. 5-48.

1. Remove the diagonal chassis brace to replace the drive belts easily.
2. The Capstan Belt (on the flywheel) is mounted shiny-side-in.
3. All other flat belts are mounted shiny-side-out.
4. Clean the belts with methyl alcohol before installation.

5-24. RELAY PULLEY REPLACEMENT

1. Remove the Capstan and Motor Belts. See Fig. 5-49.
2. Remove the four 3 mm screws shown in Fig. 5-50 and remove the pulley assembly.
3. Replace the Relay Pulley Assembly and the drive belts. The shiny side of the Motor Belt is out; the shiny side of the Capstan Belt is in.

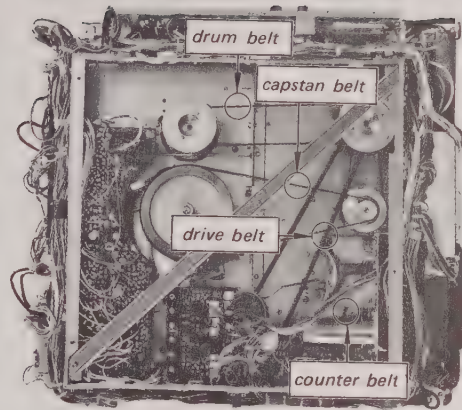


Fig. 5-48. Drive belts

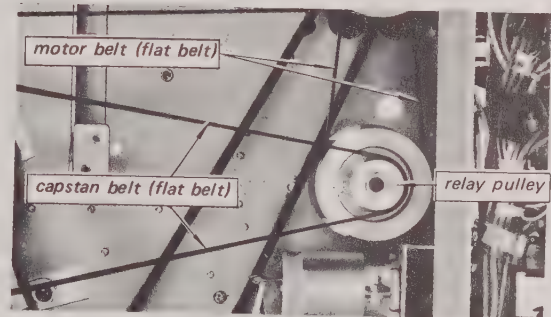


Fig. 5-49. Relay pulley removal

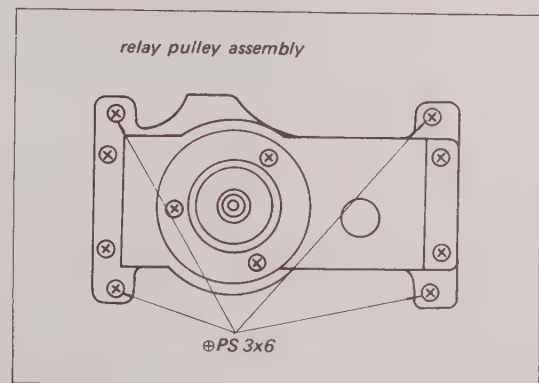


Fig. 5-50. Relay pulley assembly mount

5-25. ECCENTRIC ROLLER REPLACEMENT

1. Remove the diagonal chassis brace beneath the chassis.
2. Loosen the two 4 x 4 mm set screws and remove the Flywheel.
3. Refer to Fig. 5-51. Pull off the E4 washer on the Eccentric Roller. Apply a drop of oil to the bearing before installing the new roller.

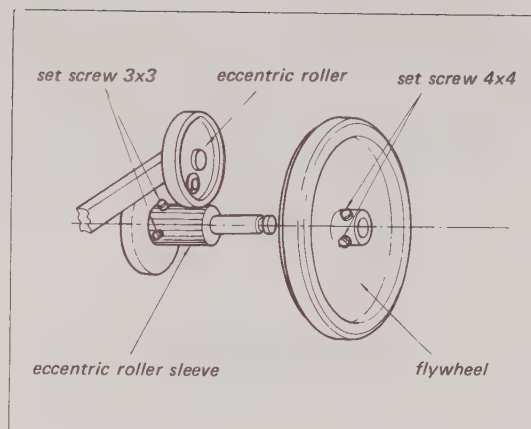


Fig. 5-51. Eccentric roller replacement

SECTION 6

POWER SUPPLY ADJUSTMENT

Preliminary Check — Power line voltage should be 120V when making power supply adjustments.

Test Equipment Requirements — Dc Voltmeter, 1% accuracy

6-1. +24V REGULATOR ADJUSTMENT

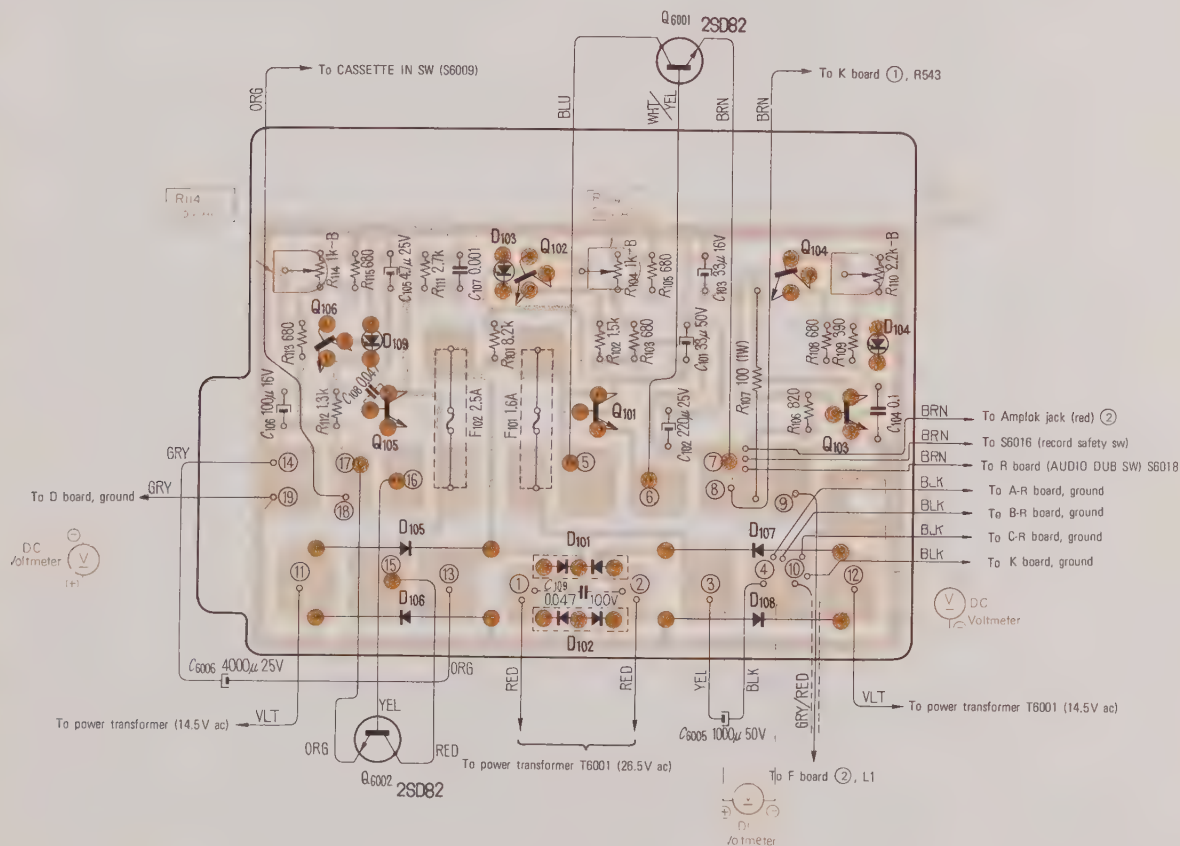
1. Connect the dc voltmeter between pin 8 (+) and pin 10 (−) of the J board.
2. Set R104 for a +24 volt reading.

6-2. +12V REGULATOR ADJUSTMENT

1. Connect the dc voltmeter between pin 9 (+) and pin 10 (−) of the J Board
2. Set R110 for a 12 volt reading.

6-3. +13V REGULATOR ADJUSTMENT

1. Connect the dc voltmeter between pin 18 (+) and pin 19 (−).
2. Set R114 for a +13 volt reading.



SECTION 7

SERVO SYSTEM ALIGNMENT

Test Equipment Requirements

- a. Color TV Monitor
- b. Oscilloscope – Tektronix 561 or equivalent.
- c. Frequency Counter – Hewlett Packard HP-5245L or equivalent
- d. Sony VIDEOCASSETTE ALIGNMENT TAPE

Adjustment Sequence - Adjustments should be made in the sequence given in the following procedures:

7-1. HEAD DRUM FREE-RUNNING SPEED CHECK

1. Disable the photo transistor by placing an opaque paper or plastic cap over the photo-transistor assembly (a black pen cap is satisfactory).
2. Disable the Cassette Load switch S6009 by shorting its terminal lugs.
3. Connect a counter or oscilloscope to TP-3 or TP-6 on the B-R (Servo) board. See Fig. 7-1.
4. Depress the PLAY button and wait for completion of the threading cycle.
5. Check for a free-running speed of 30.38 to 30.45 rps (Hz). This corresponds to a period of 32.84 to 32.92 milliseconds.

If a period counter is not available, a rough check of free-running speed may be made as follows:

Connect the scope probe to TP-11 on the B-R (Servo) board. Set up the conditions of Steps 1~4. Sync the scope from the power line. Pulses will move from right to left across the trace. Using a stop watch or a watch with a sweep second hand, time the interval it takes for ten pulses to pass some selected reference mark on the scope graticule. This interval should be between 11 and 14 seconds.

If free-running speed is out of specification, check to see if the problem is electrical or mechanical as follows:

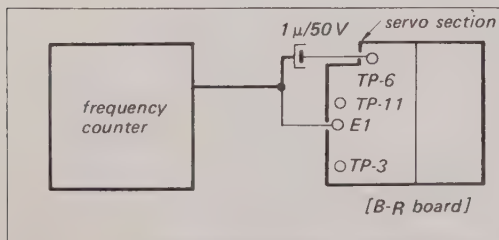


Fig. 7-1. Head drum free-running speed check test setup

Unsolder the violet lead from the brake coil at terminal 25 on the B-R (Servo) board. If this restores correct free-running speed, the servo circuits are malfunctioning.

Troubleshoot the brake coil drive circuits. If free-running speed remains incorrect, check the rubber belts for excessive wear, grease or oil. Clean and replace the head drum drive belt.

7-2. RAMP SLOPE ADJUSTMENT

1. Connect the scope to TP-9 on the B-R (Servo) board. See Fig. 7-2. Set scope sensitivity to 1 V/cm; time base to 2 msec/cm.
2. Playback the Sony VIDEOCASSETTE ALIGNMENT tape stairstep segment and adjust the scope controls to center the negative-going ramp on the waveform.
3. Adjust R37 for a slope of 0.5V per msec (5 volts in 10 msec). Refer to Fig. 7-3.

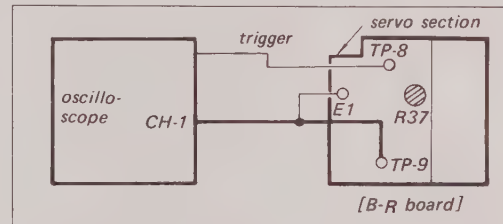


Fig. 7-2. Ramp slope adjustment test setup

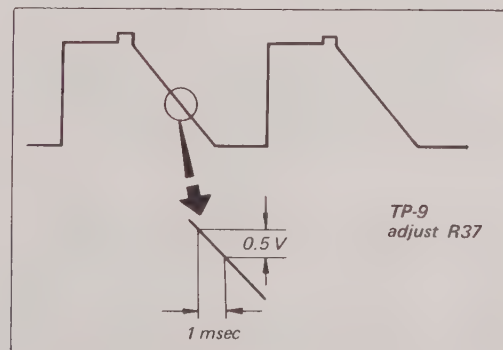


Fig. 7-3. Ramp slope adjustment

7-3. PHASE LOCK ADJUSTMENT

1. Apply a stairstep signal at 1V (p-p) to the VIDEO IN jack.
2. Connect the CH-2 probe of a dual trace scope to TP-6 on the B-R board. See Fig. 7-4.

3. Connect the CH-2 probe to TP-526 on the A-R board.
4. Trigger the scope from TP-5 on the B-R board.
5. Set up the record mode. Remember to disable the Record Safety Switch S6016 by taping down the actuator wire.
6. Observe the waveform as shown in Fig. 7-5 and adjust R34 on the B-R board for a 6.5H interval between the trailing edge of the waveform at TP-6 and the leading edge of vertical sync at TP-526.

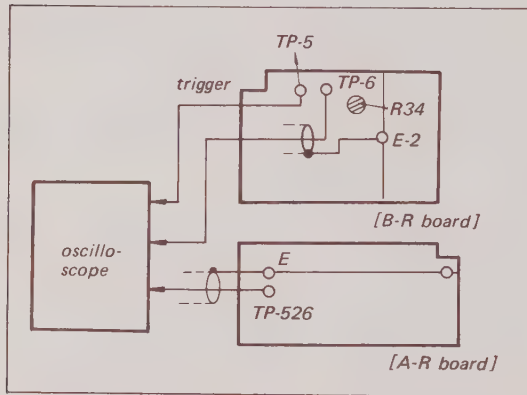


Fig. 7-4. Phase lock adjustment test setup

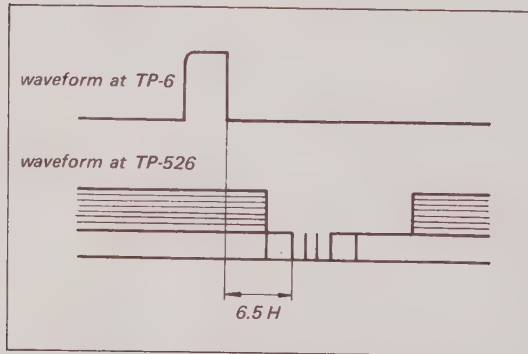


Fig. 7-5. Phase lock adjustment

7.4. TRACKING CONTROL RANGE

1. Connect the CH-1 probe of the scope to TP-4 of the B-R (Servo) board. See Fig. 7-6. Set CH-1 gain to 5 V/cm, time base to 5 msec/cm. Set sync selector to sync on CH-1 only.
2. Connect the CH-2 probe to TP-2 of the B-R (Servo) board. See Fig. 7-6. Set CH-2 gain to 5 V/cm.
3. Set R17 to mid range.

4. Set the TRACKING control fully clockwise.
5. Playback the Sony ALIGNMENT tape.
6. Adjust R20 for a 22 msec positive pulse duration for the waveform at TP-4 (CH-1). See Fig. 7-7.
7. Set the TRACKING control fully counterclockwise.
8. Adjust R17 for 8 msec between the trailing edge (negative-going) of the signal at TP-4 and the leading edge of the CTL signal at TP-2. See Fig. 7-8.
9. Turn TRACKING control fully clockwise. Trailing edge of signal at TP-4 should lag the leading edge of the CTL pulse by 8 msec. See Fig. 7-9.
10. Touch up R17 for an 8 msec lead at minimum setting of the TRACKING control. Touch up R20 for an 8 msec lag at maximum setting of the TRACKING control.

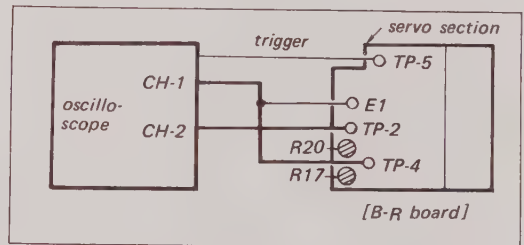


Fig. 7-6. Tracking control range adjustment test setup

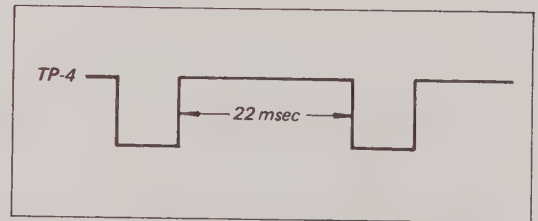


Fig. 7-7. Preliminary tracking adjustment

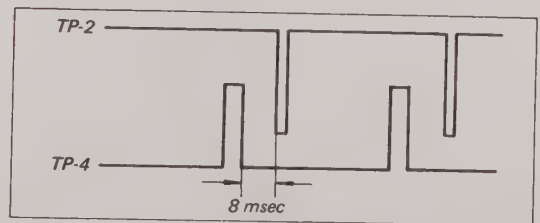


Fig. 7-8. Second tracking range adjustment (Tracking control fully counterclockwise)

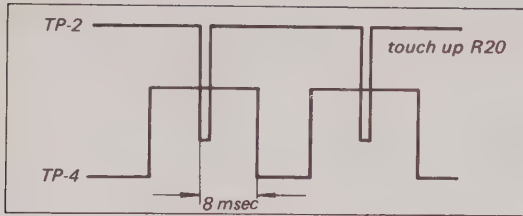


Fig. 7-9. Tracking control range final check
(Tracking control fully clockwise)

7-5. VIDEO HEAD SWITCHING POSITION

1. Connect the CH-2 probe of the scope to TP-527 (video output) of the A-R board. See Fig. 7-10. (Set CH-2 sensitivity to 0.5 V/cm.)
2. Connect the CH-1 probe to TP-6 of the B-R (Servo) board (See Fig. 7-10). Set sensitivity to 2 V/cm. Sync on CH-1 only, time base at 100 μ sec.
3. Playback the staircase segment of the ALIGNMENT tape.

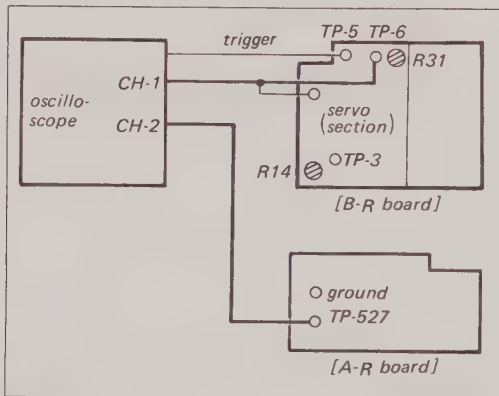


Fig. 7-10. Video head switching position adjustment test setup

4. Trigger on the positive-going (leading) edge of the 30 PG pulse (CH-1). Set scope to CHOP and observe the vertical sync interval.
5. Adjust R31 so that the negative-going (trailing) edge of the delayed 30 PG (A) pulse is 6.5 H (412.8 μ sec) ahead of vertical sync. See Fig. 7-11.
6. Transfer CH-2 probe to TP-3 on the B-R (Servo) board.
7. Set R14 so that the negative-going (trailing) edge of the 30 PG (B) pulse is 6.5 H ahead of vertical sync. See Fig. 7-11.

7-6. DROPOUT COMPENSATOR BLANKING PULSE WIDTH

1. Connect the scope probe to TP-11 on the B-R (Servo) board. See Fig. 7-12. Set sensitivity to 1 V/cm, time base at 500 μ sec/cm.
2. Playback the staircase segment of the ALIGNMENT tape.
3. Trigger on the leading (positive-going) edge of the waveform.
4. Adjust R58 for 2 msec pulse width (duration of positive-pulse). See Fig. 7-13.

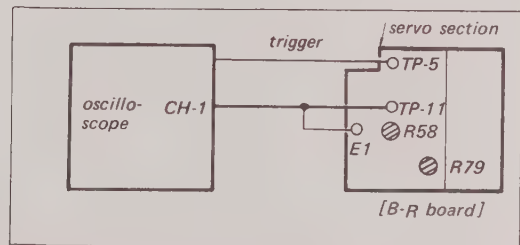


Fig. 7-12. Dropout compensator blanking pulse width adjustment test setup

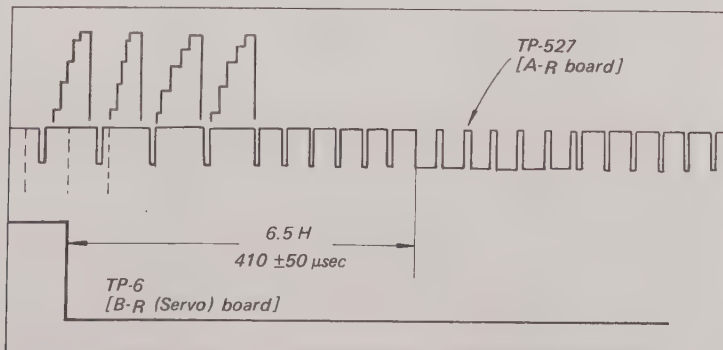


Fig. 7-11. Video head switching position

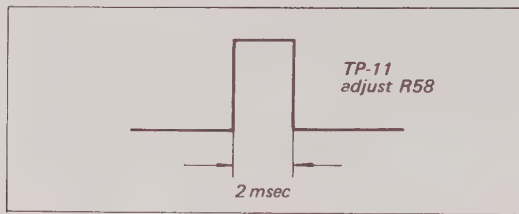


Fig. 7-13. Dropout compensator blanking pulse width

7-7. MUTING TIME

1. Place the ALIGNMENT tape in the cassette compartment.
2. Press the PLAY button.
3. Adjust R79 at B-R board (See Fig. 7-12) so that the picture appears 1.8 to 2.2 seconds after completion of the threading cycle.

7-8. RECORD MUTING TIME

1. Apply a stairstep signal at 1V (p-p) to the VIDEO IN jack.
2. Connect the scope to TP-16 on the G board. See Fig. 7-14.
3. Set up the record mode. (Be sure that the Record Safety Switch (S6016) is closed by taping down the actuator wire.) Time the interval between the instant the STAND BY lamp goes out and r-f appears at TP-16. See Fig. 7-14.

4. Adjust R80 for a 2 second interval for the conditions observed in Step 3.

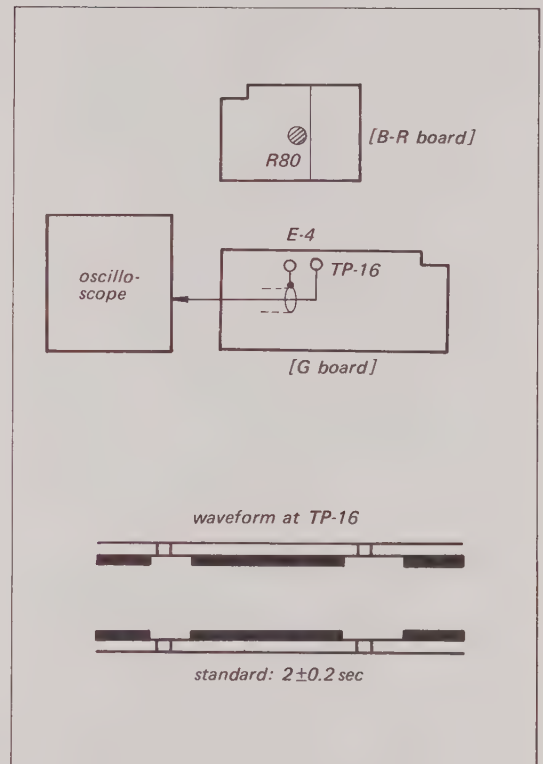


Fig. 7-14. Record muting interval

SECTION 8

VIDEO SYSTEM ALIGNMENT

Test Equipment Requirements

- a. Color TV Monitor
- b. Oscilloscope – Tektronix 561 or equivalent
- c. Frequency Counter – Hewlett Packard HP-5245L or equivalent
- d. Sony VIDEOCASSETTE ALIGNMENT TAPE
- e. Dc Voltmeter

Adjustment Sequence – Adjustments should be made in the sequence given in the following procedures. Playback adjustments are made first, followed by record adjustments.

(Playback Adjustments)

8-1. VIDEO HEAD RESONANCE AND DAMPING

1. Connect the scope to TP-401 on the B-R (R-F) board. See Fig. 8-1.
2. Trigger the scope from TP-6 on the B-R (Servo) board.
3. Playback the rf sweep segment of the Sony VIDEOCASSETTE ALIGNMENT tape.
4. Adjust C403 and R401 for a flat response between 3.58 and 5.4 MHz. See Fig. 8-2.
5. Connect the scope to TP-403 on the B-R (R-F) board. See Fig. 8-1.
6. Trigger the scope from TP-3 on the B-R (Servo) board.
7. Playback the rf sweep segment of the Sony VIDEOCASSETTE ALIGNMENT tape.
8. Adjust C411 and R416 for flat response between 3.58 and 5.4 MHz. See Fig. 8-2.

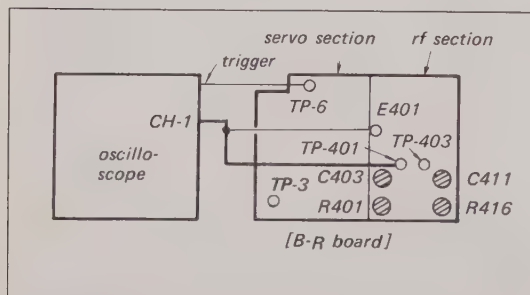


Fig. 8-1. Video head resonance and damping adjustment test setup

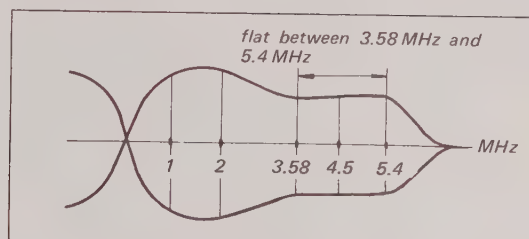


Fig. 8-2. Head response and damping

8-2. PLAYBACK EQUALIZATION

1. Connect the scope to TP-402 on the B-R (R-F) board. See Fig. 8-3.
2. Trigger the scope from TP-6 on the B-R (Servo) board.
3. Playback the rf sweep segment of the ALIGNMENT tape.
4. Adjust L401 and R411 for the response shown in Fig. 8-4.
5. Connect the scope to TP-404 on the B-R (R-F) board. See Fig. 8-3.
6. Trigger the scope from TP-3 on the B-R (Servo) board.
7. Adjust L402 and R426 for the response shown in Fig. 8-4.

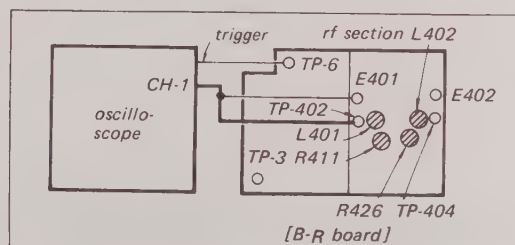


Fig. 8-3. Playback equalization adjustment test setup

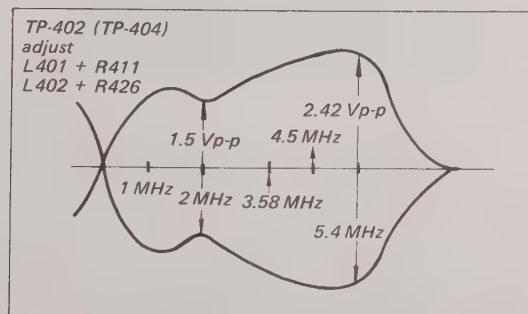


Fig. 8-4. Playback equalization

8-3. Y CHANNEL BALANCE

1. Connect the scope to TP-406 on the B-R (R-F) board. See Fig. 8-5.
2. Trigger the scope from TP-3 or TP-6 on the B-R (Servo) board.
3. Playback the staircase segment of the ALIGNMENT tape.
4. Adjust R431 for equal amplitude envelopes on alternate fields. Refer to Fig. 8-6.

8-4. Y PB OUTPUT

1. Connect the scope to TP-406 on the B-R (R-F) board. See Fig. 8-5.
2. Trigger the scope from TP-3 or TP-6 on the B-R (Servo) board.
3. Playback the staircase segment of the ALIGNMENT tape.
4. Adjust R445 for a reading of 0.2V (p-p). See Fig. 8-5.

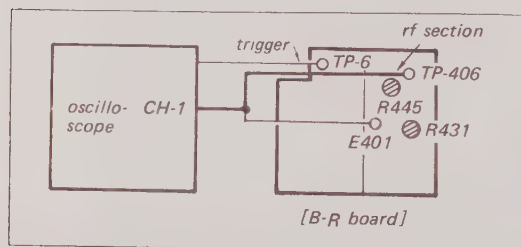


Fig. 8-5. Y pb output test setup

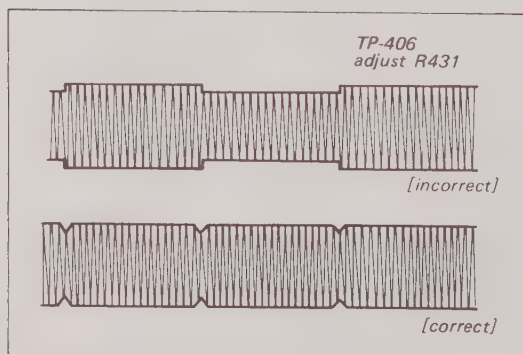


Fig. 8-6. Y-channel balance

8-5. DROPOUT COMPENSATOR SENSITIVITY

Note: Adjustment of the dropout compensator is normally made using a jig to provide simulated dropout of known amplitude and duration. Adjustments given herein are field adjustments to be performed

only if components have been replaced on the K Board. If results are not satisfactory, the K Board should be replaced.

1. Turn R520 fully counterclockwise (K board).
2. Playback a section of tape known to have noticeable dropout (usually the beginning of a much-used tape). Dropouts will appear as long black dashes followed by white transients.
3. Turn R520 clockwise slowly and stop at the point where dropouts disappear. Recheck earlier section of the tape where dropouts had been visible.

8-6. DROPOUT COMPENSATOR BALANCE

1. Playback the section of tape known to have dropouts.
2. Turn R542 (K board) fully counterclockwise and then clockwise until streaks disappear.

8-7. CARRIER BALANCE 1 AND 2

1. Connect the scope to TP-527 on the A-R board. See Fig. 8-7.
2. Playback the staircase segment of the ALIGNMENT tape.
3. Sync the scope to observe one horizontal line.
4. Adjust R667 and R678 for minimum beat at all levels of the signal. See Fig. 8-8.

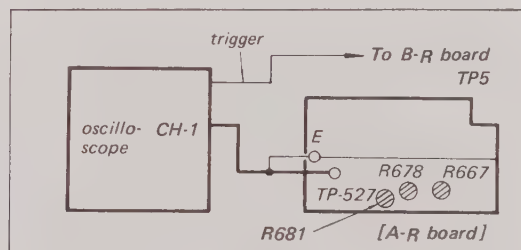


Fig. 8-7. Carrier balance adjustment test setup

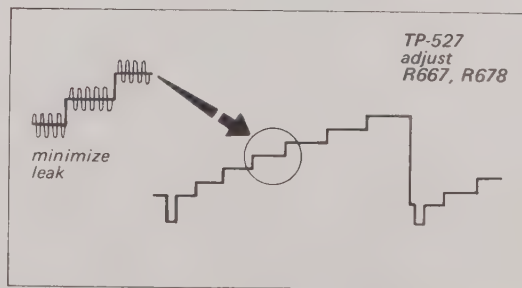


Fig. 8-8. Carrier balance

8.8. Y LEVEL ADJUSTMENT

1. Terminate the VIDEO OUT connector with 75 ohms.
2. Connect the scope to TP-527 on the A-R board.
3. Adjust R681 (See Fig. 8-7) for 1V (p-p).

8-9 3.58 MHz OSCILLATOR FREQUENCY ADJUSTMENT

1. Connect a frequency counter having a high input impedance to TP-511 on the A-R board. See Fig. 8-9.
2. Allow 15 minutes for warm-up of all equipment.
3. Set C553 for a counter reading of 3579545 ± 5 Hz.
4. Disconnect the counter.
5. Check output level at TP-511 with a scope. It should be 5.5 ± 1.0 V(p-p).

8-10. COLOR BALANCE

1. Connect the scope to TP-506 on the A-R board. See Fig. 8-10.
2. Sync scope from the AC line; time base at 5 msec/cm.
3. Playback the color bar segment of the ALIGNMENT tape.

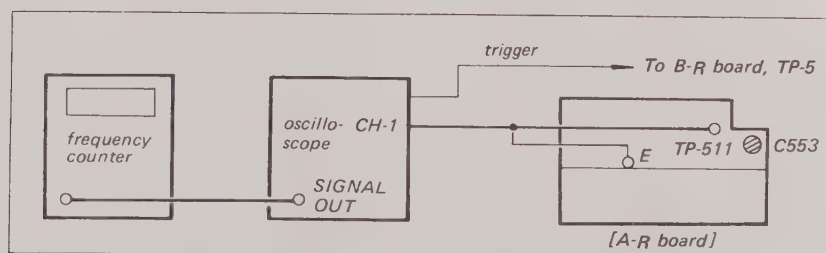


Fig. 8-9. 3.58 MHz oscillator frequency adjustment

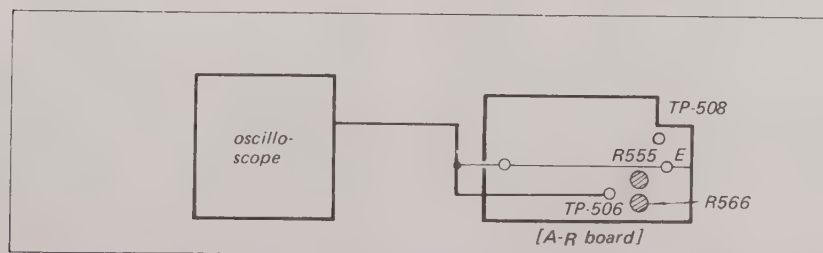


Fig 8-11. 688 kHz color level adjustment test setup

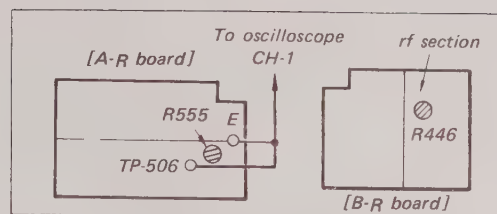


Fig. 8-10. Color balance adjustment test setup

4. Adjust R446 on the B-R (R-F) board for equal envelope output on alternate fields.

8-11. 688 kHz COLOR LEVEL

1. Connect the scope to TP-506 on the A-R board. See Fig. 8-11.
2. Playback the color bar segment of the ALIGNMENT tape.
3. Set R555 for a reading of 0.47 V (p-p).
4. Transfer the scope probe to TP-508.
5. Adjust R566 for a reading of 1.0 to 1.2 V (p-p).

8-12. COLOR AGC BLANKING

1. Connect the scope to TP-507 on the A-R board. See Fig. 8-12.
2. Sync the scope from the power line.
3. Playback the color bar segment of the ALIGNMENT tape.

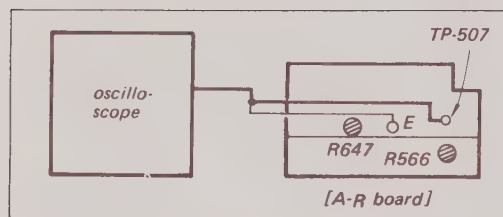


Fig. 8-12. Color AGC blanking adjustment test setup

4. Adjust R647 so that there is minimum difference in signal level between the vertical sync interval and the remainder of the waveform (continuous dc level). See Fig. 8-13.

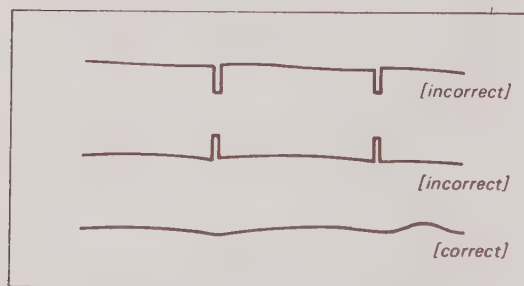


Fig. 8-13. Color AGC blanking

8-13. COLOR APC ADJUSTMENTS

1. Connect the scope to TP-514 on the A-R board. See Fig. 8-14.
2. Playback the color bar segment of the Alignment Tape.
3. Adjust the core of T503 for best burst shape. See Fig. 8-15.
4. Stop the tape.
5. Ground TP-532 with a $0.1\mu\text{F}$ capacitor. See Fig. 8-16.
6. Connect the scope or a dc voltmeter to TP-529 on the A-R board. See Fig. 8-16.
7. Adjust R725 for a reading of 1.5 volts dc.
8. Connect a frequency counter to TP-530. See Fig. 8-17.
9. Adjust L512 for a reading of $688,374 \pm 300$ Hz.
10. Remove the capacitor installed in Step 5 and connect the scope to TP-532.
11. Adjust L513, L514 and L515 for maximum amplitude.
12. Connect the scope to TP-528. See Fig. 8-18.
13. Adjust R612 for 2V(p-p).

14. Ground TP-532 with a $0.1\mu\text{F}$ capacitor. See Fig. 8-16.
15. Connect the scope to TP-529.
16. Playback the color-bar segment of the Alignment Tape.
17. Adjust R726 for 1.5 volts dc.
18. Remove the capacitor installed in Step 14.

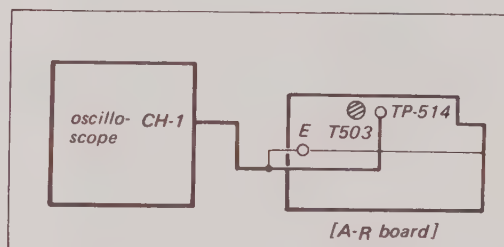


Fig. 8-14. Color APC adjustment test setup (1)

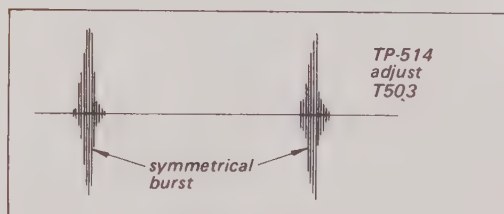


Fig. 8-15. Color APC

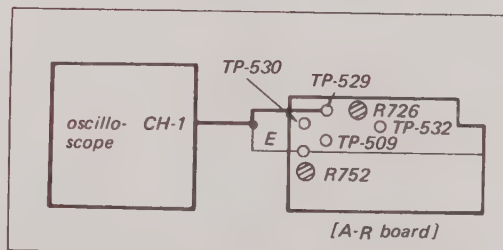


Fig. 8-16. Color APC adjustment test setup (2)

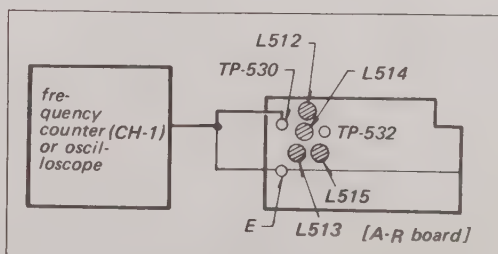


Fig. 8-17. Color APC adjustment test setup (3)

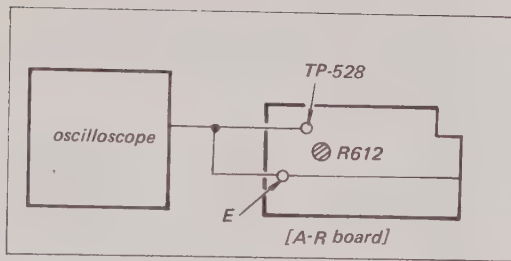


Fig. 8-18. Color APC adjustment test setup (3)

8-14. Y MIX LEVEL

1. Terminate the VIDEO OUT connector with 75 ohms.
2. Connect the scope probe to TP-527 on the A-R board. See Fig. 8-19.
3. Playback the color bar segment of the ALIGNMENT tape.
4. Adjust R708 for 1 V (p-p) (peak white).

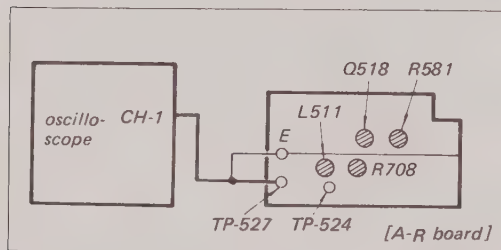


Fig. 8-19. Y mix level, 3.58 MHz trap and color mix adjustment test setup

8-15. 3.58 MHz TRAP

1. Place scope probe at TP-524 as shown in Fig. 8-19.
2. Playback the color bar segment of the ALIGNMENT tape.
3. Adjust L511 for minimum 3.58 MHz in the color bar sections of the waveform.

8-16. COLOR MIX ADJUSTMENT

1. Repeat Steps 1 and 2 of Section 8-14.
2. Playback the color bar segment of the ALIGNMENT tape.
3. Adjust R581 for a burst signal of 0.3 V (p-p) See Fig. 8-19.

Record Circuit Adjustment

- Note:**
1. The following adjustments are made with the machine in the E-to-E and record modes. If these modes are set up without a cassette in the holder, disable the Record Safety switch S6016 by taping down the actuator wire.
 2. Adjustments should be made with a standard video input signal 1V (p-p), 0.7V white and 0.3V sync, applied at the VIDEO IN jack. Set the INPUT SIGNAL SELECTOR to EXTERNAL.
 3. All of the following adjustments are on the G board unless otherwise noted.

8-17. VERTICAL DRIVE LEVEL CHECK

There are no adjustments in this procedure. It is included to make sure that the servo board is supplied with the correct vertical drive signal.

1. Connect the scope probe to TP-2 on the G board. See Fig. 8-20.
2. Apply a 1V (p-p) stairstep signal to the VIDEO IN jack.
3. Set up the E-to-E mode by depressing the RECORD button.
4. The waveform at TP-2 should appear as shown in Fig. 8-20, $17 \pm 2V$ (p-p).

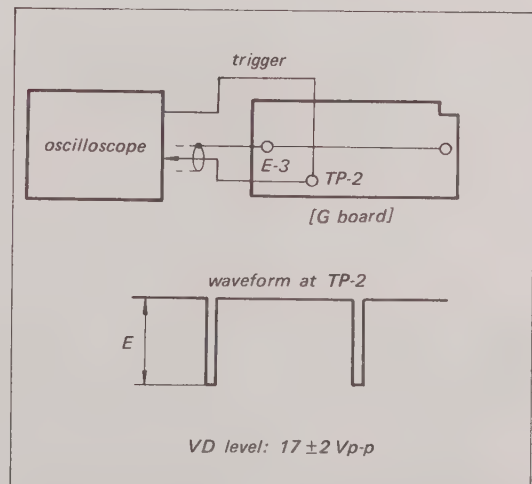


Fig. 8-20. Check of servo reference signal in record mode

8-18. LUMINANCE AGC LEVEL

1. Connect the scope probe to TP-3 on the G board. Trigger the scope from TP-2 or use interval sync. See Fig. 8-21.
2. Set up the E-to-E mode by depressing the RECORD button. Input signal - 1V (p-p) staircase.
3. Adjust R36 for a level at TP-3 to 1.0V (p-p). See Fig. 8-21.
4. Check the waveform at TP-4. Sync the scope internally and set the time base $10\mu\text{sec}/\text{cm}$. The negative spike following horizontal sync should exceed peak white (more negative).

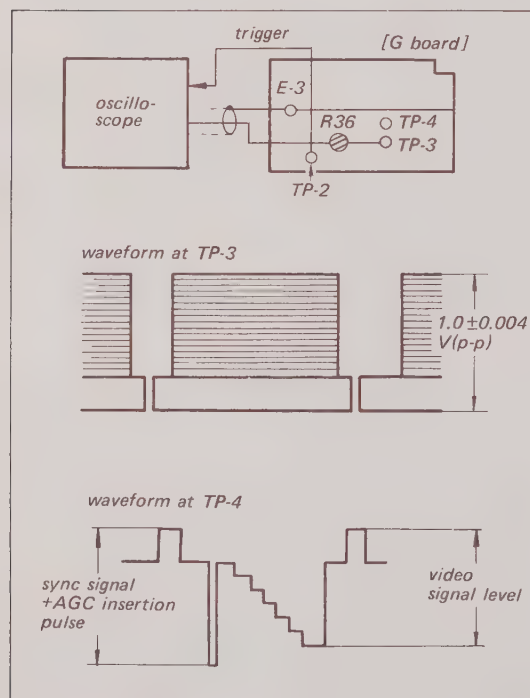


Fig. 8-21. Luminance AGC level

8-19. MODULATOR ADJUSTMENTS

Sync-tip Frequency

(Refer to Fig. 8-22.)

1. Set R83 (white clip) fully clockwise.
2. Remove the video input signal.
3. Connect a frequency counter or scope to TP-8 on the G board. Trigger the scope internally. See Fig. 8-22.
4. Adjust L8 for a counter reading of 3.8 MHz. If a scope is used, set the calibrated time

base to $0.5\mu\text{sec}/\text{cm}$. Adjust L8 for 19 complete waveforms in 10 cm.

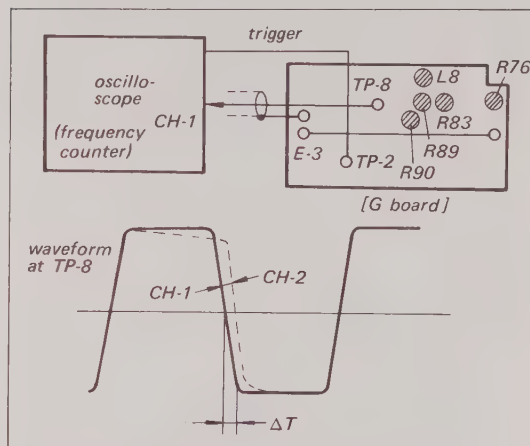


Fig. 8-22. Waveform symmetry adjustment

Carrier Balance or Waveform Symmetry

5. Connect both probes of a dual-trace scope to TP-8. Make sure that both channels of the scope have identical gains.
6. Set the mode switch to ALT. Adjust gain controls to superimpose both waveforms perfectly.
7. Invert channel 2 (or channel 1) on the scope.
8. Adjust R89 and R90 for perfect waveform symmetry. See Fig. 8-22.
9. Recheck sync-tip frequency by following Steps 1-4 after symmetry has been adjusted.

Peak-White frequency

10. Apply a 1V (p-p) staircase signal to the VIDEO IN jack.
11. Connect the CH-1 probe of the scope to TP-8. See Fig. 8-23.
12. Trigger the scope externally from TP-12. Set the time-base to $10\mu\text{sec}/\text{cm}$ and adjust scope sync to stop the waveform.
13. Connect an r-f signal generator (0.1V (p-p)) to the CH-2 input of the scope. Set the generator to 5.35 MHz.
14. Set the mode switch on the scope to ADD.
15. Identify the peak-white bar on the added waveform and adjust R76 for an indication of zero beat. (sine waves during the peak-white interval will flatten to horizontal lines).

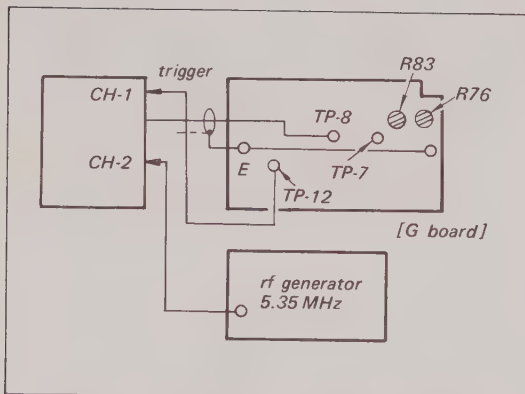


Fig. 8-23. Peak-white frequency adjustment test setup

White-Clip

16. Connect the scope to TP-7 and make sure that the conditions set up on the previous steps are unchanged.
17. Set the scope gain controls so that the peak-white to sync signal occupies 2 divisions. See Fig. 8-24 (Ignore spikes.) Adjust R83 (white clip) so that signals 0.8 divisions above peak white are clipped.

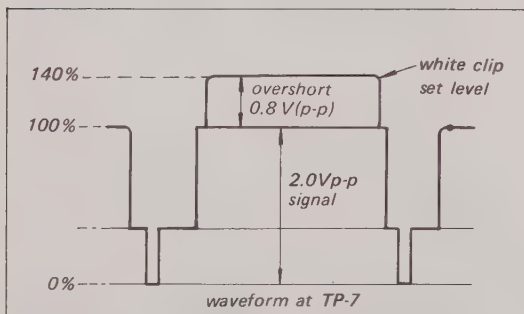


Fig. 8-24. White-clip adjustment

8-20. ACC (COLOR AGC) ADJUSTMENT

1. Apply a 1V (p-p) color bar signal (75%) to the VIDEO IN jack.
2. Set up the E-to-E mode.
3. Connect the scope probe to TP-13 on the G board (use internal sync, 10 μ sec/cm time base). See Fig. 8-25.
4. Adjust L10 for the waveform shown in Fig. 8-25.

5. Transfer the scope probe to TP-11.
6. Adjust R135 (ACC Level) for a burst amplitude of 0.45V (p-p) (or 1.0V (p-p) chrominance (if 75% color bars are used). See Fig. 8-26.

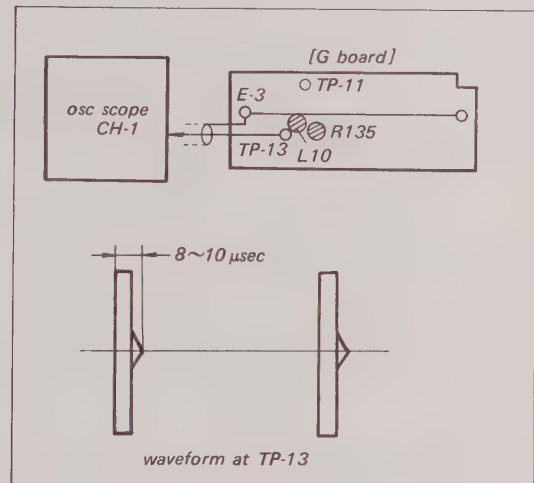


Fig. 8-25. Burst-gate tuning

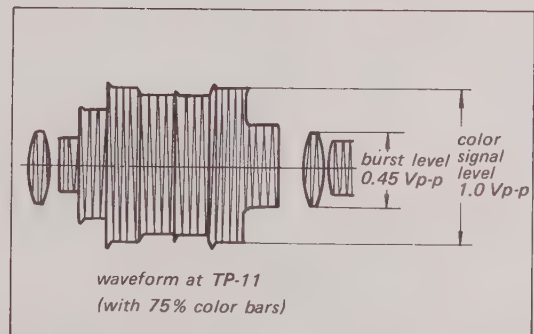


Fig. 8-26. ACC adjustment

8-21. COLOR MODE Y LEVEL ADJUSTMENT

1. Apply color-bars at 1V (p-p) to the VIDEO IN jack.
2. Set up the E-to-E mode.
3. Connect the scope probe to TP-5 on the G board. See Fig. 8-27.
4. Adjust R52 for a reading of 1.0V (p-p).

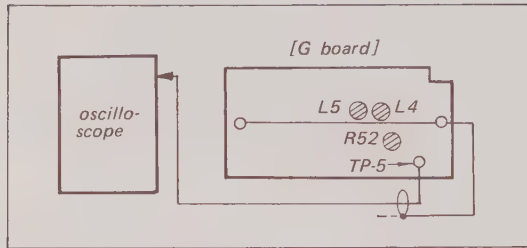


Fig. 8-27. Color mode Y level adjustment test setup

8-22. 3.58 MHz TRAP ADJUSTMENTS

1. Repeat Steps 1 to 3 of the previous procedure.
2. Adjust L4 and L5 for minimum 3.58 MHz signals on the Y signal. See Fig. 8-28.

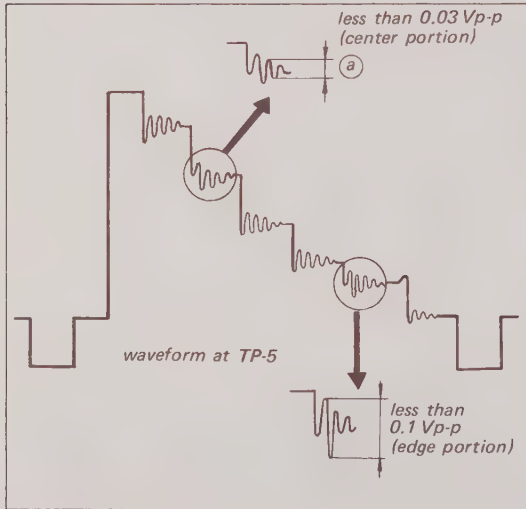


Fig. 8-28. Chrominance (3.58 MHz) trap adjustment

8-23. COLOR KILLER THRESHOLD

A color-bar signal with variable burst is required for this adjustment.

1. Apply the color-bar signal to the VIDEO IN jack.
2. Connect the CH-1 probe of a dual-trace scope to TP-1 on the G board.
3. Connect the CH-2 probe of the scope to TP-18 on the G board. Set input of scope to DC and sensitivity to 5V/cm. A d-c voltmeter may also be used at this test point. See Fig. 8-29.

4. Reduce burst amplitude at TP-1 to 0.085V (p-p).
5. Adjust R143 for zero volts dc at TP-18.
6. Reduce burst amplitude at TP-1 to 0.075V (p-p).
7. Reset R143 for 23V dc at TP-18.
8. Repeat Steps 4 to 7 to obtain the conditions noted in Steps 5 and 7.

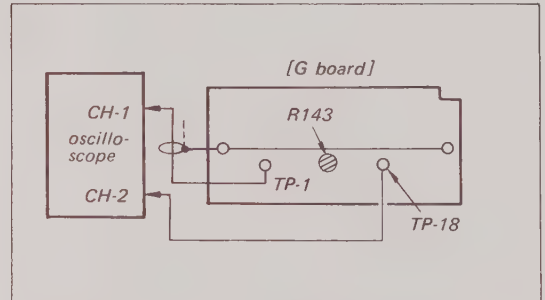


Fig. 8-29. Color killer threshold adjustment test setup

8-24. 4.27 MHz OSCILLATOR ADJUSTMENT

1. Apply a 1V (p-p) color-bar signal to the VIDEO IN jack and set up the E-to-E mode.
2. Connect a frequency counter to TP-14 on the G board. See Fig. 8-30.
3. Adjust C109 for a reading of 4,267,919 Hz. See Fig. 8-30.
4. Check output level at TP-14 with the scope. It should be $0.55 \pm 0.1V$ (p-p).

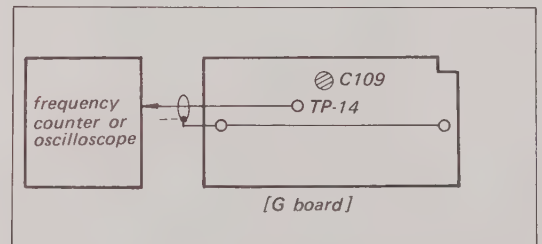


Fig. 8-30. 4.27 MHz oscillator adjustment test setup

8-25. COLOR E-to-E LEVEL

1. Apply a 1V (p-p) color-bar signal to the VIDEO IN jack and set up the E-to-E mode.
2. Connect the scope to the emitter of Q50 on the G board. See Fig. 8-31.
3. Adjust R161 for a burst level of 0.054V (p-p) or 0.12V (p-p) for the full chrominance signal (75% color bars).

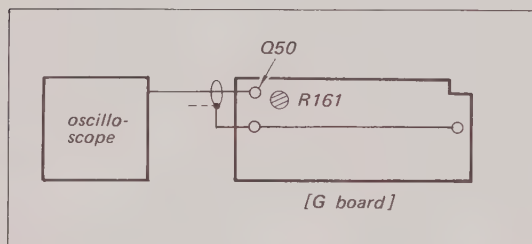


Fig. 8-31. Color E-to-E level adjustment test setup

8-26. Y RECORD LEVEL ADJUSTMENT

The following adjustments are made for both A and B video heads. Items in parenthesis refer to the test points in the B channel.

1. Apply stairstep signal to the VIDEO IN jack.
2. Install a blank cassette
3. Connect the scope probe to TP-19 (TP-20) on the V board. See Fig. 8-32.
4. Connect a microphone to the L/DUB jack.
5. Start the recording.
6. Adjust R184 (R186) on the B-R board for scope readings of 0.9, 0.95, 1.0, 1.05 and 1V (p-p).

Record each level change by voice.

7. Connect the scope to TP-402 (TP-404) on the B-R board.
8. Playback the section of tape recorded in Step 6 and note the input level (as recorded by voice) that produces maximum playback output.
9. Set up the Record mode and set R184 (R186) for the signal level noted in Step 8.
10. Repeat Steps 1-9 for the B channel (items in parenthesis).

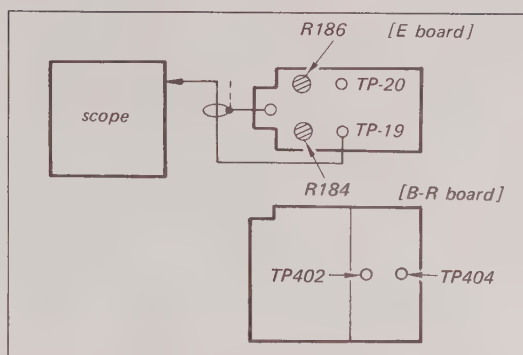


Fig. 8-32. Y record level adjustment test setup

8-27. CHROMINANCE RECORD LEVEL ADJUSTMENT

1. Apply a 1V (p-p) color-bar signal to the VIDEO IN jack.
2. Connect the scope to TP-21 on the V board. See Fig. 8-33.
3. Set up the E-to-E mode.
4. Adjust R162 for a burst level of 0.45V (p-p) or 1.0V (p-p) total chrominance (75% color bars).

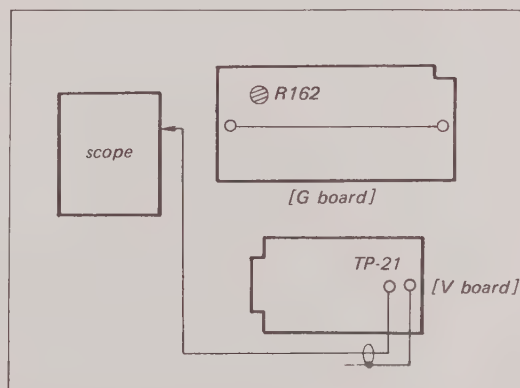


Fig. 8-33. Chrominance record level adjustment test setup

8-28. RECORD FREQUENCY CHARACTERISTICS

Factory Branch Adjustment

1. Lift the input lead from terminal 3 of the V board.
2. Connect a video sweep generator to terminal 3 through a 0.01 μ F capacitor. See Fig. 8-34.

3. Connect a current probe around the hot lead of the A head at the output of the V board, terminal 7. (B head at terminal (9)). Set sweep width to 6 MHz. See Fig. 8-34.
4. Set up the RECORD mode.
5. Set the sweep generator output level for 47 ma (p-p) at 5 MHz.
6. Adjust R195 (R223) and R197 (R226) for the response shown in Fig. 8-35.
7. Repeat these adjustments for the B channel (items in parenthesis).

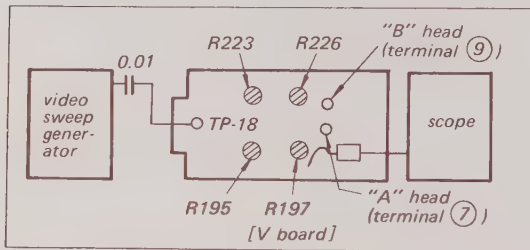


Fig. 8-34. Record frequency characteristics adjustment test setup

8-29. Y BIAS TRAP ADJUSTMENT (AUDIO DUB)

1. Disconnect signal from the VIDEO IN jack.
2. Prepare the low-pass filter shown in Fig. 8-36, and connect it to the scope.
3. Connect the low-pass filter to TP-405 on the B-R board. See Fig. 8-36.
4. Make a zero-signal recording.
5. Playback the blank recording and set up the AUDIO DUB mode.

6. Adjust L403 for minimum signal as shown in Fig. 8-36.

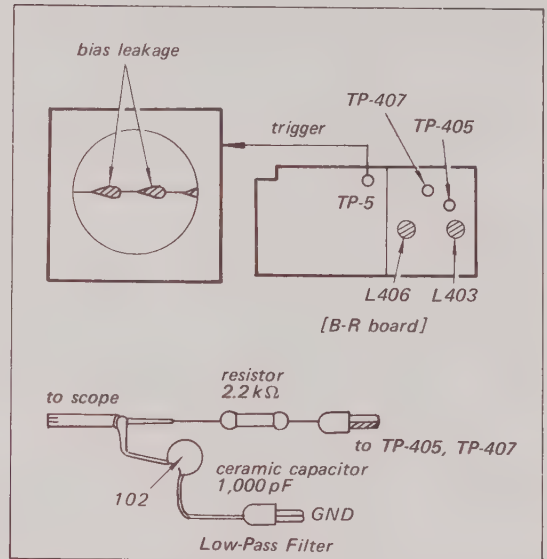


Fig. 8-36. Y bias/audio dub bias trap adjustment test setup

8-30. CHROMINANCE BIAS TRAP ADJUSTMENT

1. Connect the scope to TP-407 on the B-R board using the low-pass filter shown in Fig. 8-36.
2. Disconnect the input from the VIDEO IN jack and make a zero-signal recording.
3. Playback the recording mode in Step 2 and set up the AUDIO DUB mode.
4. Adjust L406 for minimum bias leakage.

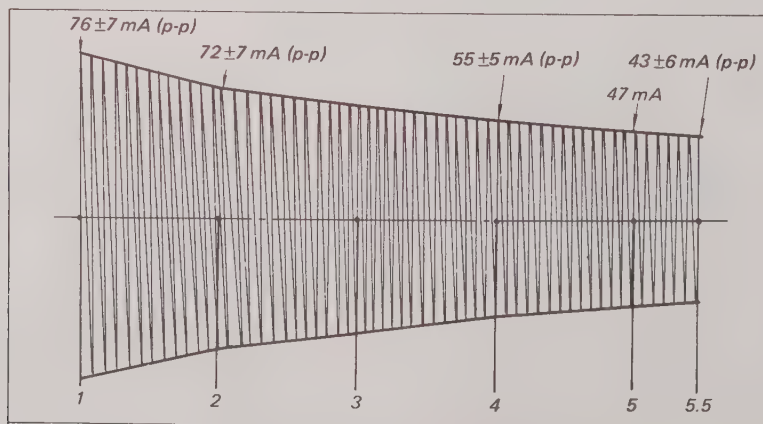


Fig. 8-35. Record characteristic

SECTION 9

AUDIO SYSTEM ALIGNMENT

Test Equipment Requirements

- a. Sony VIDEOCASSETTE ALIGNMENT TAPE
- b. Ac VTVM
- c. 10 k- Ω resistor
- d. Audio generator

9-1. AUDIO/CTL HEAD AZIMUTH AND TILT ADJUSTMENTS

1. Connect the VTVM (or oscilloscope) to TP-2 (left channel only) on the C-R board. See Fig. 9-1.
2. Playback the 10-kHz segment of the Alignment Tape.
3. Adjust the azimuth and tilt adjust screws on the Audio/CTL head mount for maximum output. See Fig. 9-2.

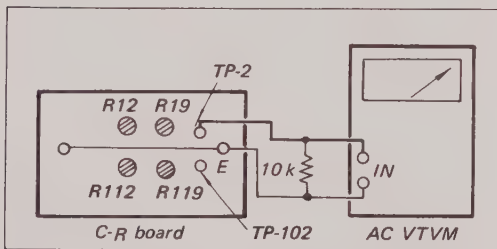


Fig. 9-1. Audio system alignment test setup

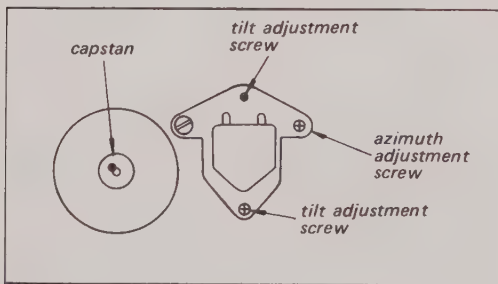


Fig. 9-2. Adjustment parts location

9-2. PLAYBACK LEVEL ADJUSTMENT

1. Connect an ac VTVM to TP-2 on the C-R board (L-CH). See Fig. 9-1.
2. Terminate the L-CH LINE OUT connector with 10 k ohms.
3. Playback the 1-kHz segment of the Alignment Tape.
4. Adjust R19 for a zero dB reading.
5. Transfer the ac VTVM probe to TP-102 on the

C-R board (R-CH). See Fig. 9-1.

6. Terminate the R-CH LINE OUT connector with 10 k ohms.
7. Replay the 1-kHz segment of the Alignment Tape.
8. Adjust R119 for a 0 dB (0.775 V) reading.

9-3. PLAYBACK FREQUENCY RESPONSE

1. Perform Procedure 9-2 prior to making this check.
2. Connect an ac VTVM to TP-2 on the C-R board. See Fig. 9-1.
3. Terminate the L LINE OUT connector with 10 k ohms.
4. Playback the 10-kHz segment of the Alignment Tape.
5. Check to see that output level is $-10\text{dB} \pm 3\text{dB}$. Adjust R12 for a -10dB reading, if necessary. (Note, the 10 kHz tone is recorded at a -10dB level on the Alignment Tape.)
6. Transfer the ac VTVM probe to TP-102 on the C-R board. See Fig. 9-1.
7. Terminate the R LINE OUT connector with 10 k ohms.
8. Playback the 10-kHz segment of the Alignment Tape.
9. Check to see that output level is $-10\text{dB} \pm 3\text{dB}$. If necessary, adjust R112 for a -10dB reading.

9-4. E-to-E LEVEL

1. Set the INPUT SIGNAL SELECTOR to EXT position.
2. Apply a 1 kHz 0-dB signal to the L AUX IN jack.
3. Connect a 10 k Ω load across the L LINE OUT jack and monitor load voltage with an ac VTVM.
4. Set up the E-to-E mode (Disable the Record Safety Switch by taping down its actuator wire.)
5. Adjust R217 on the H board for a 0 dB reading. See Fig. 9-3.
6. Repeat Steps 1 to 4 for the right channel and adjust R317 for a 0 dB reading. See Fig. 9-3.

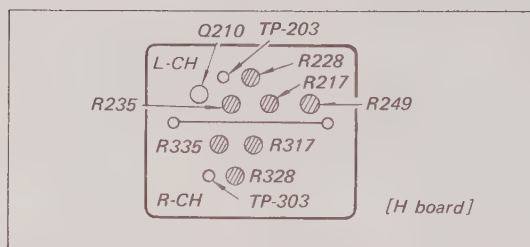


Fig. 9-3. Parts location

9-5. AGC BALANCE ADJUSTMENT

1. Set the INPUT SIGNAL SELECTOR to EXT position.
2. Apply a 1 kHz 0 dB signal to both L and R AUX IN jacks in parallel.
3. Connect a 10 k Ω load across the R LINE OUT jack and monitor output with an ac VTVM.
4. Set up the E-to-E mode.
5. Note output reading and transfer load and VTVM to the L LINE OUT jack. The difference between readings should be within 1 dB.
6. Increase signal level to 10 dB and repeat Steps 3 to 5. The difference between readings should be within 3 dB.
7. If the conditions in Steps 5 and 6 are not met, adjust AGC balance, R249 (See Fig. 9-3) on the H board to secure proper operation.

9-6. AGC DECAY-TIME CHECK

1. Set the INPUT SIGNAL SELECTOR to EXT position.
2. Set up the conditions of Steps 2 and 3 of Section 9-5.
3. Adjust the input signal to +20 dB.
4. Set up the E-to-E mode.
5. Drop the input signal level suddenly to -20 dB and note the minimum level to which output signal drops.
6. Repeat Step 5 several times and time the interval taken for output level to rise 10 dB above the minimum level noted in Step 5. This interval should exceed 15 seconds. Select values for C233 to correct decay time.

9-7. BIAS OSCILLATOR LEVEL CHECK AND ADJUSTMENT

Note: Followings should be performed after replacing the erase head.

1. Connect the scope probe to TP-403 on the E board. See Fig. 9-4.
2. Set up the record mode using a blank cassette.
3. Check the waveform. The output voltage should be 210 V (peak-to-peak) or more without distortion. Adjust R401.

9-8. AUDIO BIAS ADJUSTMENT

1. Set up the record mode without applying any signals. Use a blank cassette.
2. Connect an ac VTVM or oscilloscope to TP-203 (TP-303) on the H board. See Fig. 9-3.
3. Adjust the L401 (L402) (See Fig. 9-4) on the E board for a minimum output.
4. Apply a 1 kHz -20 dB signal to the AUX IN, L-CH jack and connect a microphone to the MIC-IN, R-CH.
5. Short the base of Q210 on the H board to ground. Refer to Fig. 9-3.
6. Connect an ac VTVM to TP-401 on the E board. See Fig. 9-4.
7. Set up the record mode using a blank cassette.
8. Adjust C406 to alter bias voltage in 1 volt steps from 25 to 38 volts and call out the values into the microphone.
9. Playback the cassette and find the value of bias voltage that yields maximum playback level. Reconnect the VTVM to the L LINE-OUT jack, using a 10 k Ω load, for this purpose.
10. Set up the record mode and set C406 for a reading at TP-402 that is 0.5 dB lower than the value noted in Step 9.
11. Repeat Steps 4 to 10 to set bias for the right channel. Reverse microphone and signal-input connections, and monitor bias at TP-401. Adjust C405.
12. Remove the short from the base of Q210.

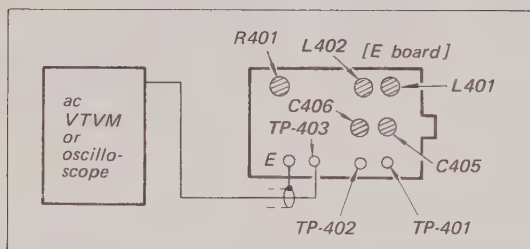


Fig. 9-4. Bias oscillator level and audio bias adjustment

9-9. RECORDING LEVEL ADJUSTMENT

1. Check playback level using the SONY Alignment Cassette. See Section 9-2.
2. Set the INPUT SIGNAL SELECTOR to EXT position, and then apply a 1 kHz -10 dB signal to the L AUX IN jack.
3. Make a recording of this tone.
4. Playback the recording and monitor output level using a 10 k Ω load at the L LINE OUT jack.
5. Output level should be 0 dB $\pm$ 2 dB.
6. If the condition of Step 5 is not met, adjust R228 (See Fig. 9-3) and repeat Steps 2 to 5.
7. Repeat Steps 1 to 6 for the right channel. Adjust R328 (See Fig. 9-3) as required in Step 6.

9-10. OVERALL FREQUENCY RESPONSE

1. Short the base of Q210 on the H board to ground. Refer to Fig. 9-3.
2. Set the INPUT SIGNAL SELECTOR to EXT position, and then apply a -30 dB signal at 70 Hz to the AUX IN, L channel.
3. Make a recording and adjust the frequency of the applied signal to 400 Hz, 1 kHz, 3 kHz, and 10 kHz. Maintain input at -30 dB for all frequency settings.
4. Playback the tape and monitor output at the L LINE OUT jack. Output voltage at the various input frequencies should conform to the following.

70 Hz	0 $\pm$ 3 dB
400 Hz	0 $\pm$ 1 dB
1 kHz	0 $\pm$ 1 dB
3 kHz	0 $\pm$ 2 dB
10 kHz	0 $\pm$ 2, -4 dB

5. If the conditions in Step 4 cannot be met, reset R235 (See Fig. 9-3) and repeat Steps 1-4.
6. Perform the same check for the right channel (adjust R335).

9-11. BIAS TRAP ADJUSTMENT IN AUDIO DUB MODE

1. Set up the AUDIO DUB mode without applying any signals. Use a blank cassette.
2. Connect an ac VTVM or oscilloscope to TP-402. See Fig. 9-4.
3. Adjust the dummy coil L6003 on the R board (See Fig. 9-5) mounted on the record function button assembly for a same value as in the RECORD mode.
4. Transfer the input lead of VTVM or oscilloscope to TP-101 and TP-102 (See Fig. 9-6) on the C-R board, and then set up the AUDIO DUB mode by using a blank cassette.
5. Adjust the L101 and L102 (See Fig. 9-6) for a minimum reading at TP-101 and TP-102 respectively.

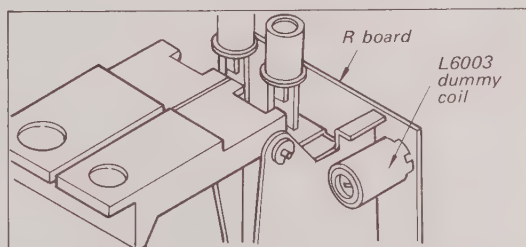


Fig. 9-5. Audio dub dummy coil adjustment

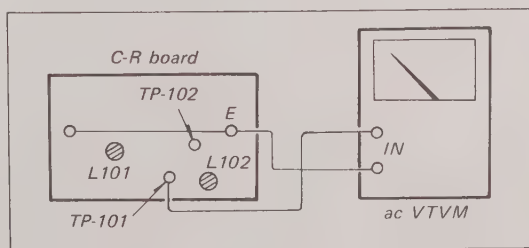


Fig. 9-6. Audio dub bias trap adjustment test setup

SECTION 10

REPACKING

The VO-1600's original shipping carton and packing materials are the ideal containers for shipping the unit. However to secure the maximum pro-

tection, the VO-1600 must be repacked in these materials precisely as before. The proper repacking procedures are shown in Fig. 10-1.

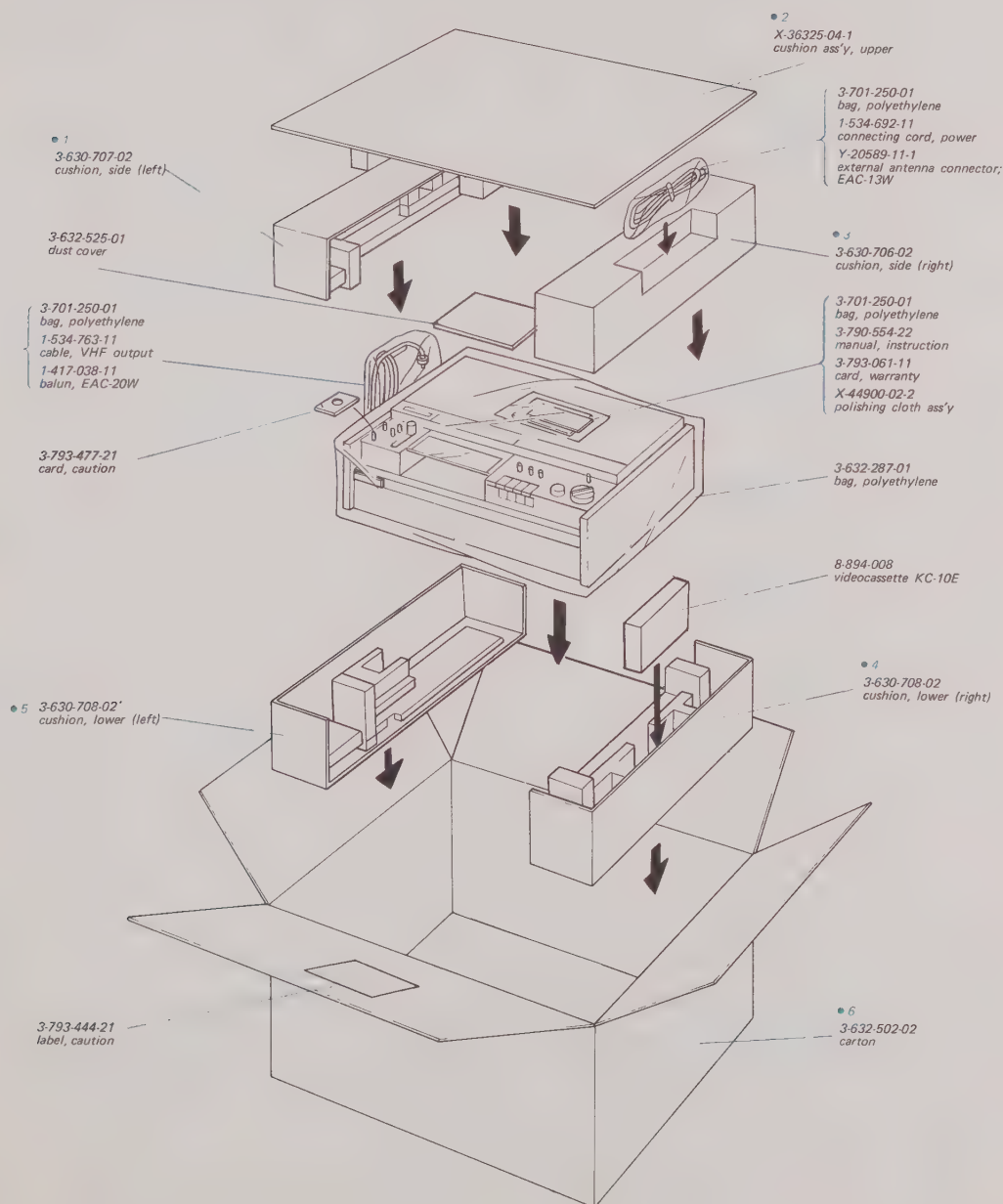


Fig. 10-1. Repacking

SECTION 11

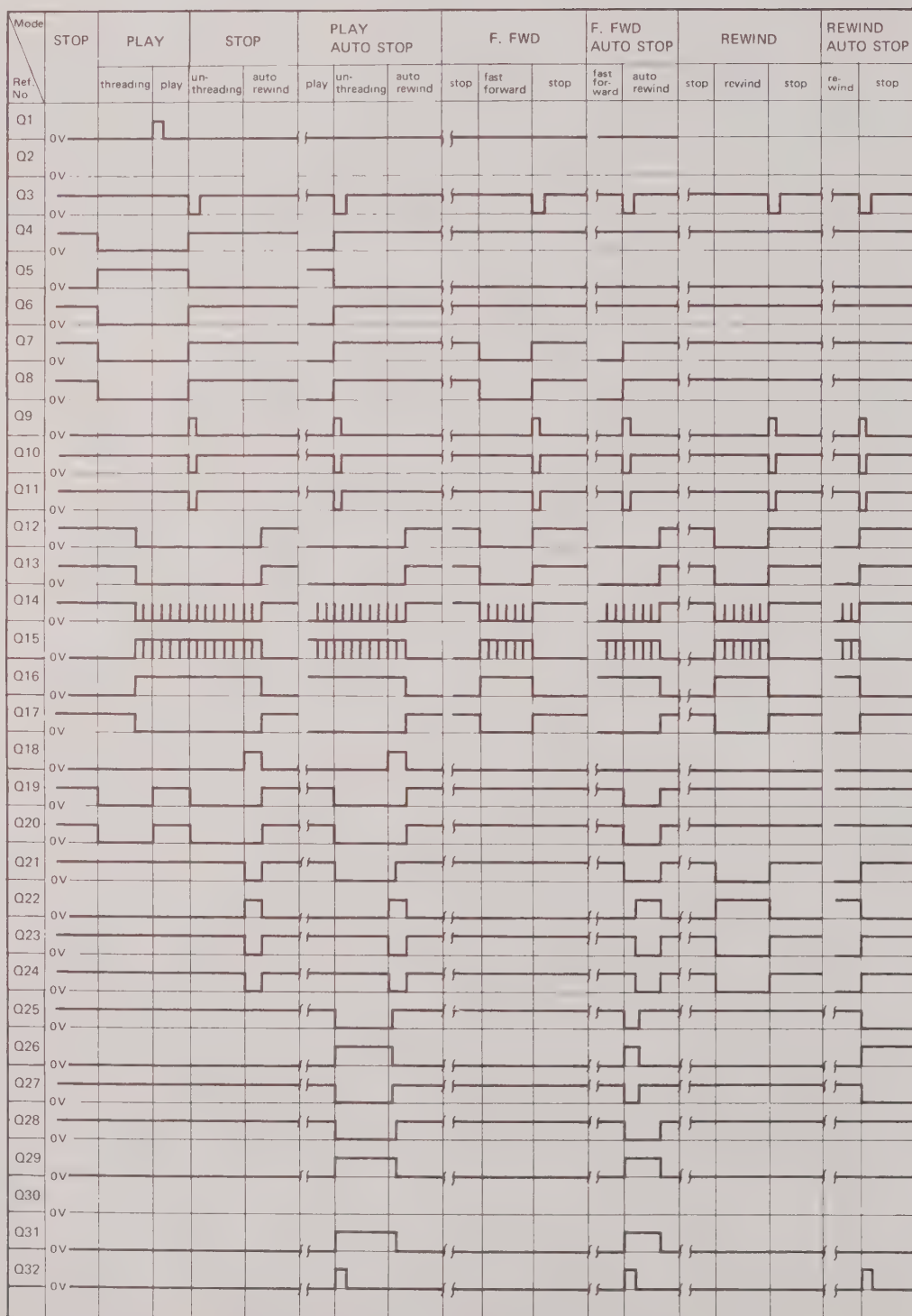
CHARTS AND DIAGRAMS

11-1. SYSTEM CONTROL VOLTAGE CHART — D Board —

	STOP		PLAY				FINISH UN- THREADING		F. FORWARD		REWIND		PLAY →		F.F. →	
			THREADING		PLAY								AUTO STOP		AUTO STOP	
	Vb (volt)	Vc	Vb (volt)	Vc	Vb (volt) Vc		Vb (volt)	Vc	Vb (volt)	Vc	Vb (volt)	Vc	Vb (volt)	Vc	Vb (volt)	Vc
Q1	0.65	0.05	0.65	0.05	0	8.7	0.65	0.05	0.65	0.05	0.65	0.05	0.65	0.05	0.65	0.05
Q2	0.02	0.02	0.02	0.02	0.65	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Q3	0.02	10	0.02	9.1	0.02	9.1	0.65	0.05	0.02	9.1	0.02	9.1	0.65	0.05	0.65	0.05
Q4	0	9.4	0.65	0.05	0.65	0.05	0	9.4	0	9.4	0	9.4	0	9.4	0	9.4
Q5	0.65	0.05	0.02	5.6	0.02	5.6	0.65	0.05	0.65	0.05	0.65	0.05	0.65	0.05	0.65	0.05
Q6	0.04	13	0.8	0.35	0.8	0.35	0.04	13	0.04	13	0.04	13	0.04	13	0.04	13
Q7	0.03	13	1.4	0.8	1.4	0.8	0.03	13	1.4	0.8	0.03	13	0.03	13	0.03	13
Q8	0.15	13	0.75	0.8	0.75	0.8	0.15	13	0.75	0.8	0.15	13	0.15	13	0.15	13
Q9	0.65	0.05	0.65	0.05	0.65	0.05	0	5	0.65	0.05	0.65	0.05	0	5	0	5
Q10	0.05	13	0.05	13	0.05	13	1.3	0.95	0.05	13	0.05	13	1.3	0.95	1.3	0.95
Q11	0.1	13	0.1	13	0.1	13	0.75	0.95	0.1	13	0.1	13	0.75	0.95	0.1	13
Q12	0.01	13	1.35	0.77	1.35	0.77	1.35	0.77	1.35	0.77	1.35	0.77	1.35	0.77	1.35	0.77
Q13	0.01	13	0.75	0.77	0.75	0.77	0.75	0.77	0.75	0.77	0.75	0.77	0.75	0.77	0.75	0.77
Q14	0.02	4.2	0.02	4.2	0.02	4.2	0.02	4.2	0.02	4.2	0.02	4.2	0.02	4.2	0.02	4.2
Q15	0.65	0.06	0.65	0.06	0.65	0.06	0.65	0.06	0.65	0.06	0.65	0.06	0.65	0.06	0.65	0.06
Q16	0.65	0.1	0.36	5	0.36	5	0.36	5	0.36	5	0.36	5	0.36	5	0.36	5
Q17	0.09	13	0.8	0.16	0.8	0.16	0.8	0.16	0.8	0.16	0.8	0.16	0.8	0.16	0.8	0.16
Q18	0.65	0.04	0.65	0.04	0.65	0.04	0	7.5	0.65	0.04	0.65	0.04	0	7.5	0.65	0.04
Q19	0	13	1.35	0.9	0	13	1.35	0.9	0	13	0	13	1.35	0.9	1.35	0.9
Q20	0	13	0.75	0.9	0	13	0.75	0.9	0	13	0	13	0.75	0.9	0.75	0.9
Q21	0.01	9.4	0.01	9.4	0.01	9.4	0.65	0.05	0.01	9.4	0.65	0.05	0.65	0.05	0.65	0.05
Q22	0.65	0.05	0.65	0.05	0.65	0.05	0.03	7.4	0.65	0.05	0.03	7.4	0.03	7.4	0.03	7.4
Q23	0.04	13	0.04	13	0.04	13	1.45	0.8	1.45	0.8	1.45	0.8	1.45	0.8	1.45	0.8
Q24	0.04	13	0.04	13	0.04	13	0.75	0.8	0.04	13	0.75	0.8	0.75	0.8	0.75	0.8
Q25	0.02	6.2	0.02	6.2	0.02	6.2	0.02	6.2	0.02	6.2	0.02	6.2	0.6	0.06	0.6	0.06
Q26	2.4	1.8	2.4	1.8	2.4	1.8	2.4	1.8	2.4	1.8	2.4	1.8	0.06	1.6	0.06	1.6
Q27	0.6	2.4	0.6	2.4	0.6	2.4	0.6	2.4	0.6	2.4	0.6	2.4	0.6	2.4	0.6	2.4
Q28	0.06	7.3	0.06	7.3	0.06	7.3	0.06	7.3	0.06	7.3	0.06	7.3	0.65	0.07	0.65	0.07
Q29	0.65	0.07	0.65	0.07	0.65	0.07	0.65	0.07	0.65	0.07	0.65	0.07	0.06	7.3	0.06	7.3
Q30	0	0.08	0	0.08	0	0.08	0	0.08	0	0.08	0	0.08	0	0.08	0	0.08
Q31	0.07	Ve=0.1	0.07	Ve=0.1	0.07	Ve=0.1	0.07	Ve=0.1	0.07	Ve=0.1	0.07	Ve=0.1	0.65	Ve=8.	0.65	Ve=8.
Q32	0.65	0.06	0.65	0.06	0.65	0.06	0.65	0.06	0.65	0.06	0.65	0.06	0	7.5	0	7.5

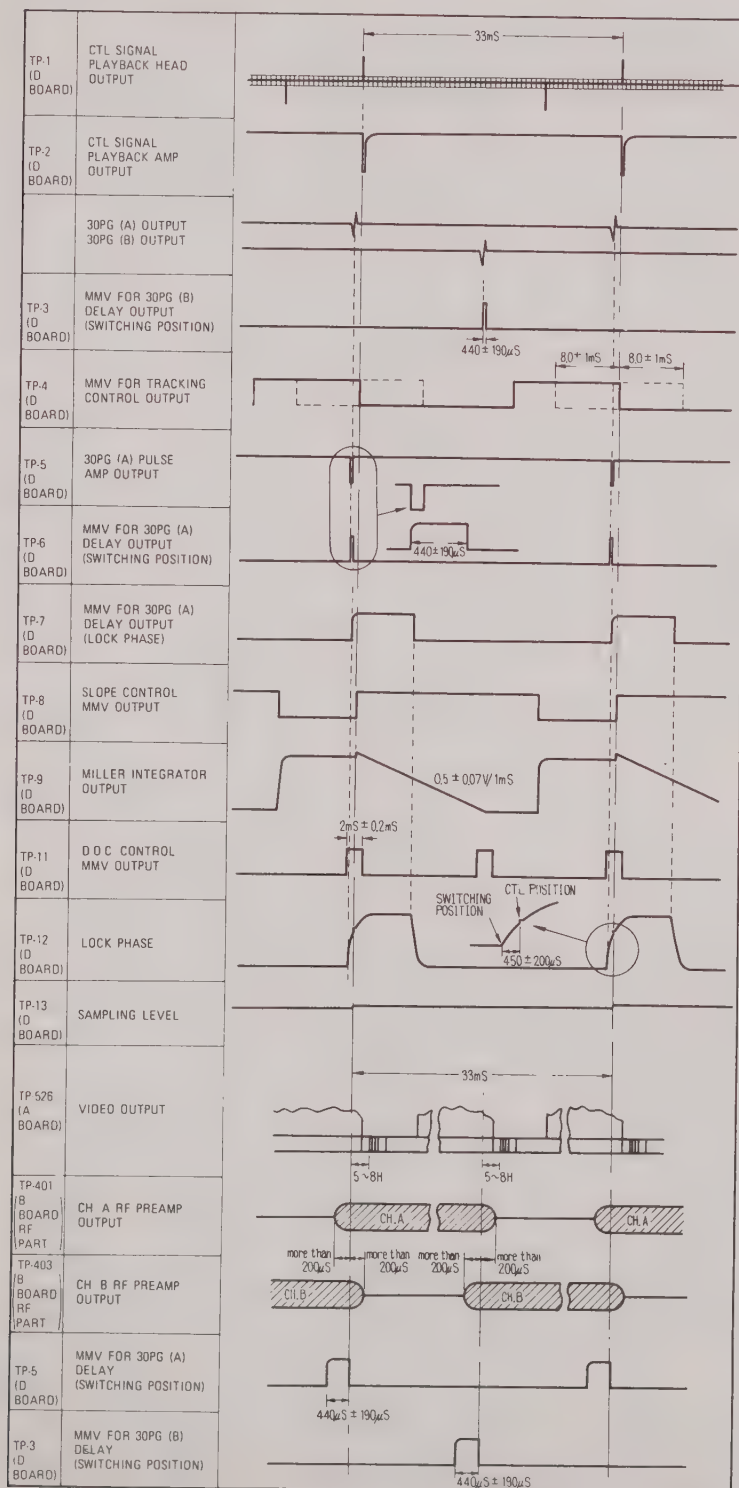
Note: Vb: base voltage
Vc: collector voltage
Ve: emitter voltage

11-2. SYSTEM CONTROL TIMING CHART – D Board –



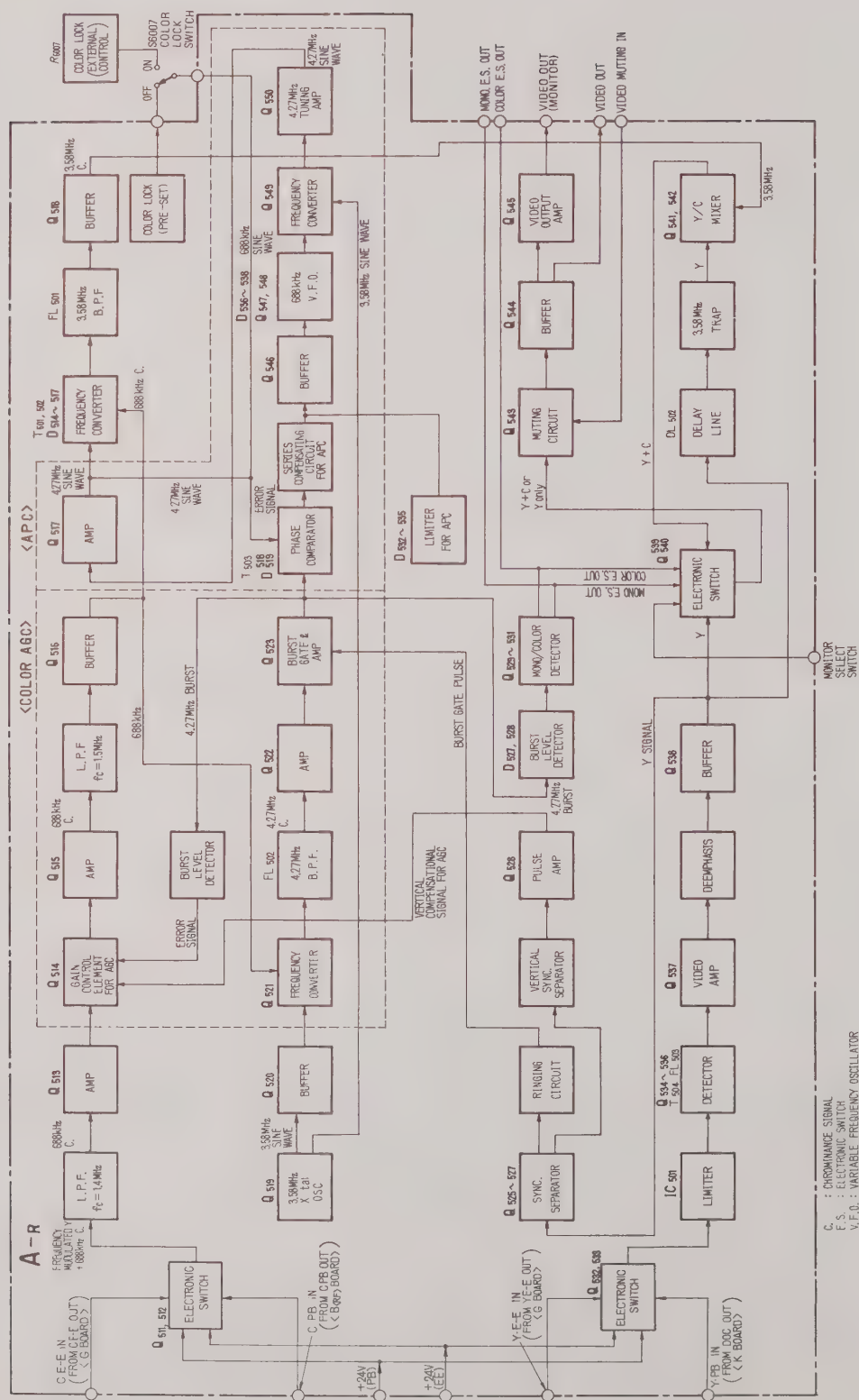
Note: All waveforms are measured at the collector except Q31.
The waveform of Q31 is measured at the emitter.

11-3. SERVO SYSTEM TIMING CHART – A-R, B-R, C-R Board –

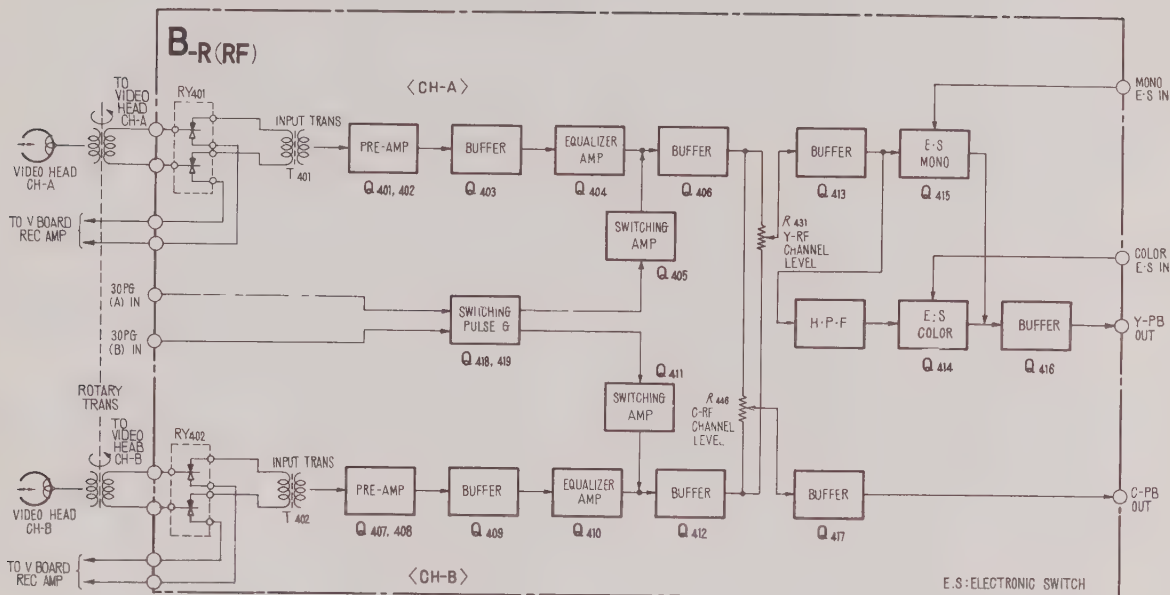
**Note:**

MMV: MONOSTABLE MULTIVIBRATOR
 30PG: 30 Hz PULSE GENERATOR
 DDC: DROPOUT COMPENSATOR

Note: All reference numbers of components in this diagram are in 1000 series.

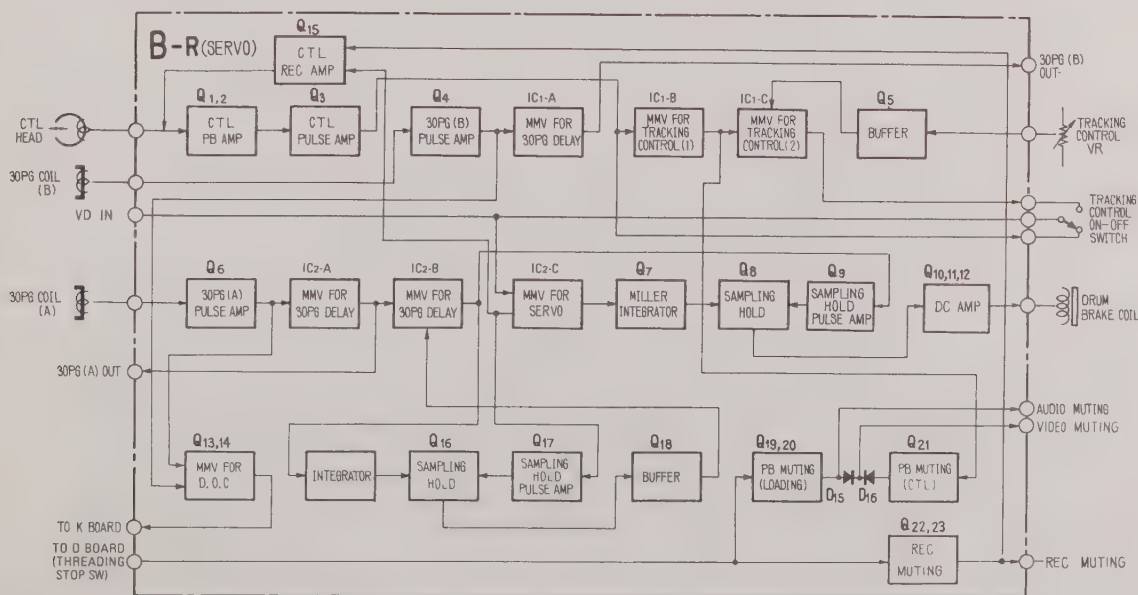


11-5. BLOCK DIAGRAM — B-R Board — (RF Section)



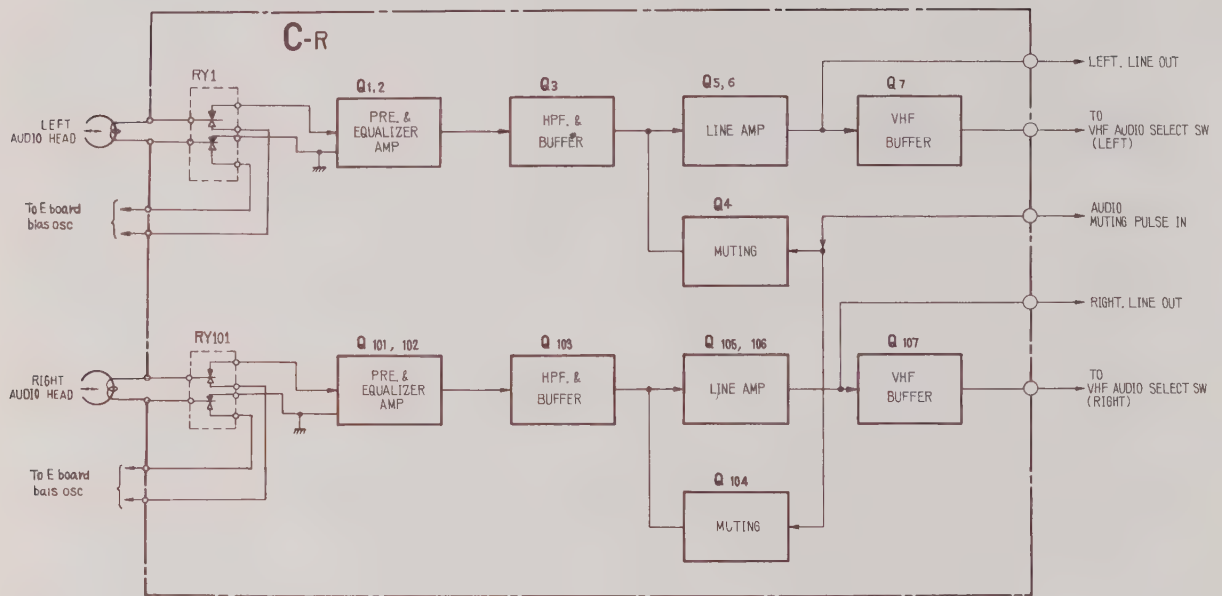
Note: All reference numbers of components in this diagram are in 1000 series.

(SERVO Section)



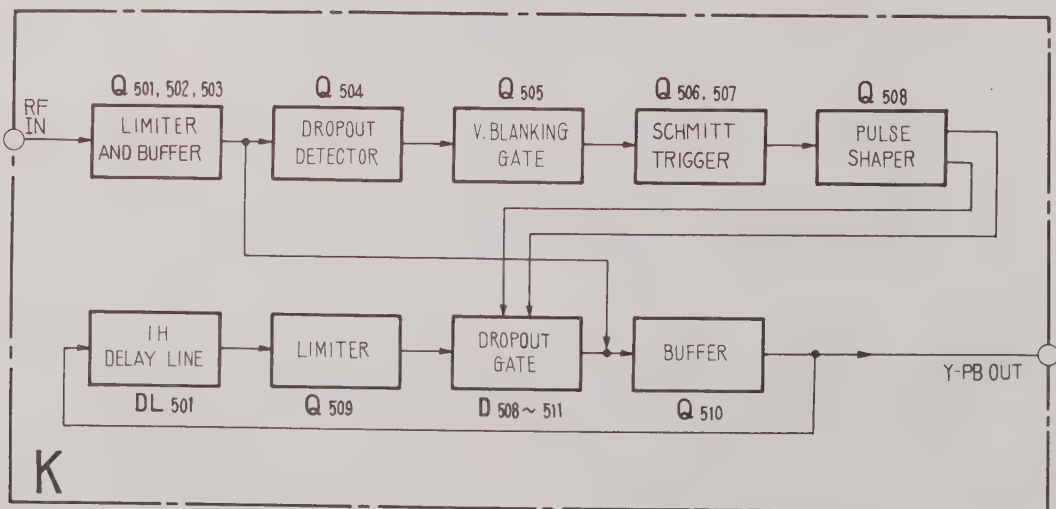
Note: All reference numbers of components in this diagram are in 3000 series.

11-6. BLOCK DIAGRAM — C-R Board and K Board — (C-R Board)



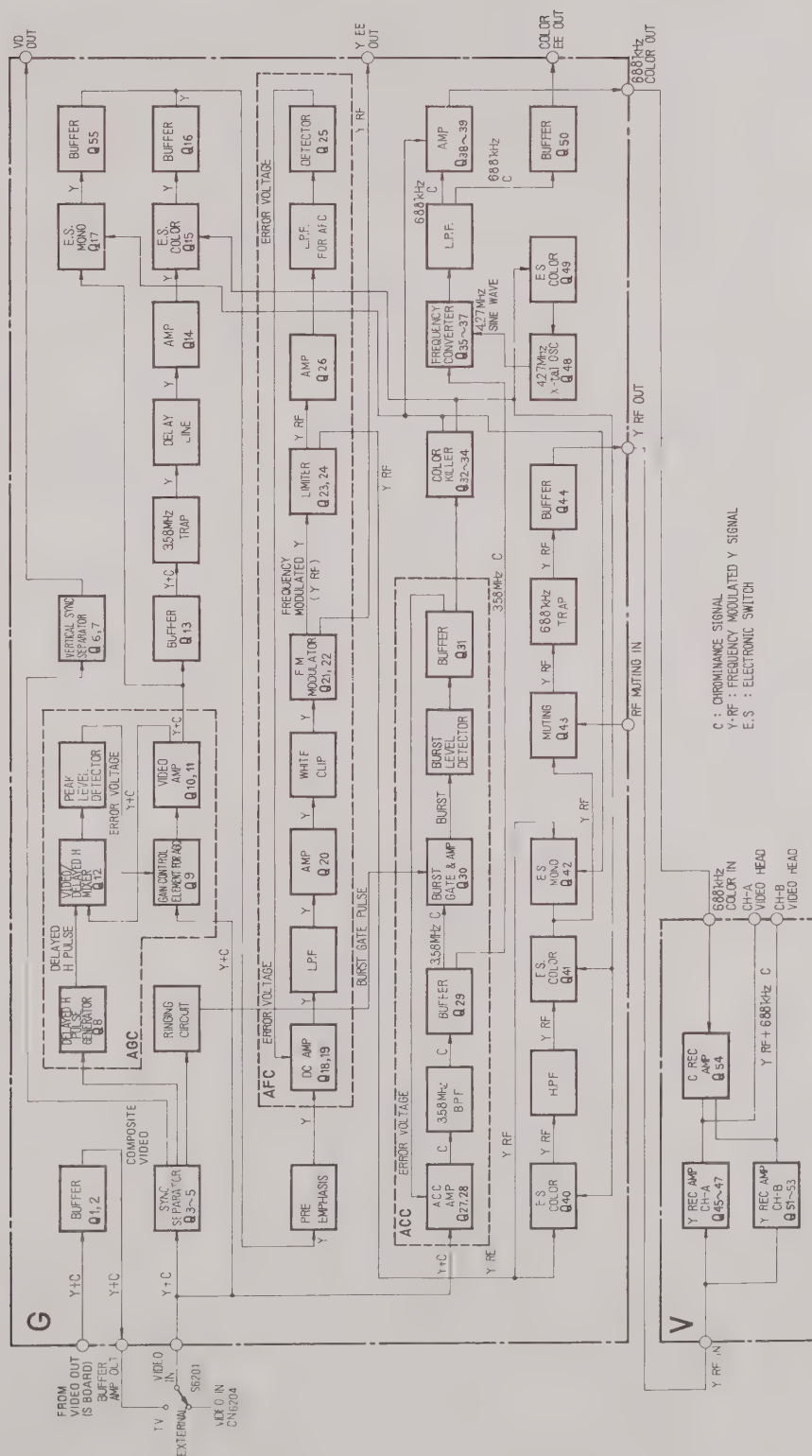
Note: All reference numbers of components in this diagram are in 2000 series.

(K Board)



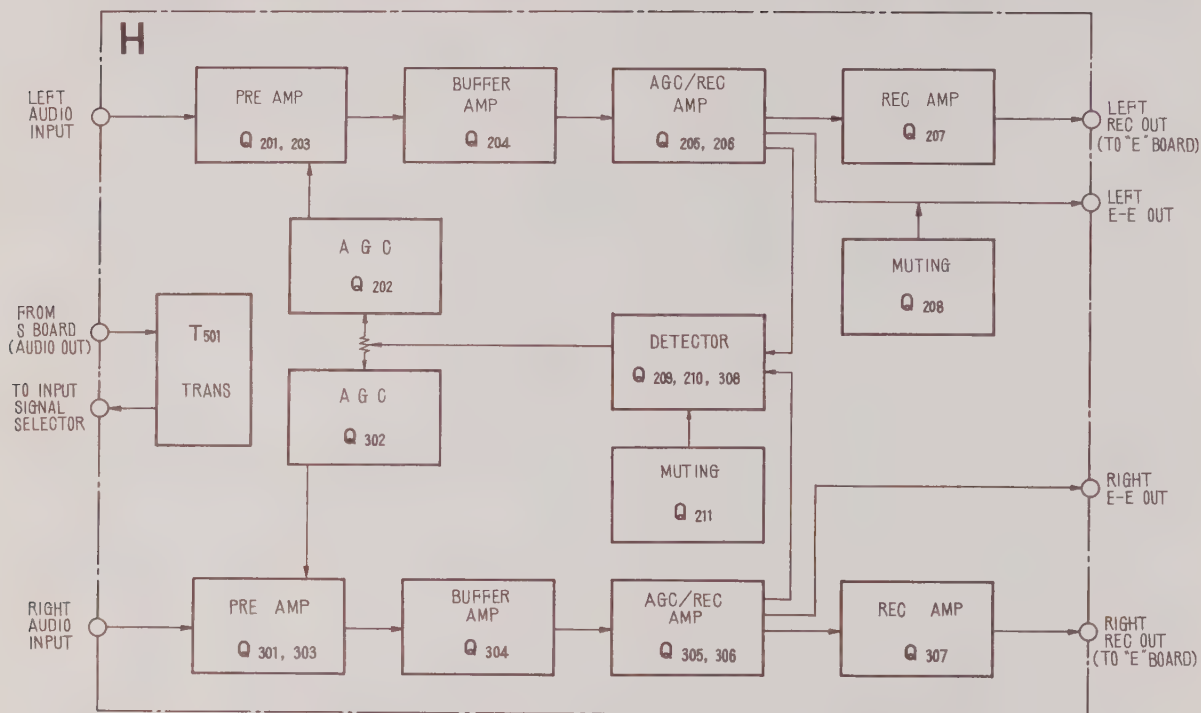
Note: All reference numbers of components in this diagram are in 1000 series.

11-7. BLOCK DIAGRAM – G Board and V Board –



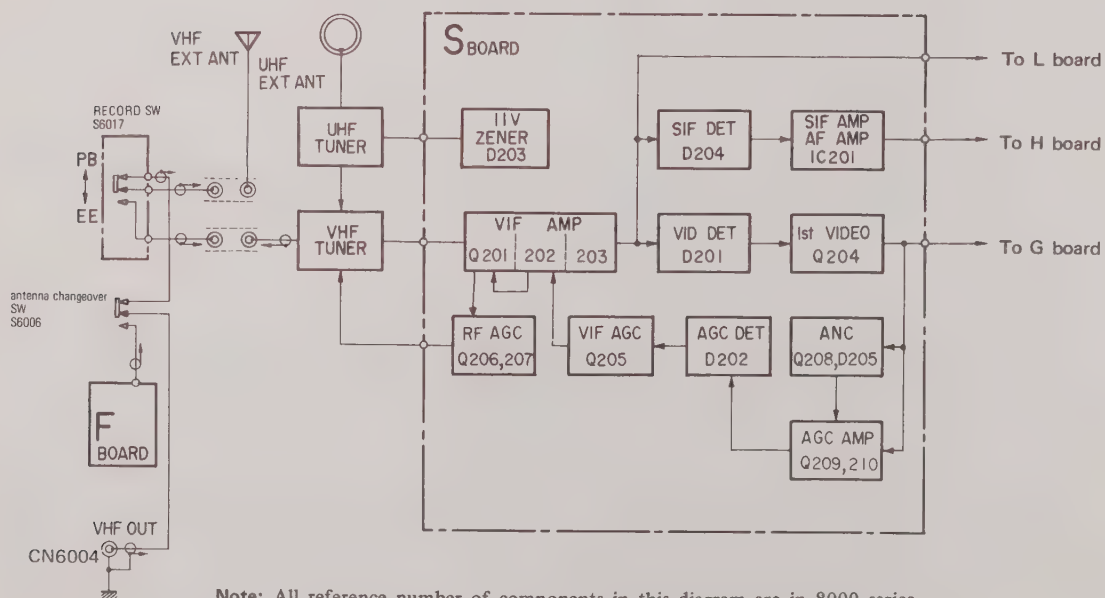
Note: All reference numbers of components in this diagram are in 1000 series.

11-8. BLOCK DIAGRAM — H Board and S Board —



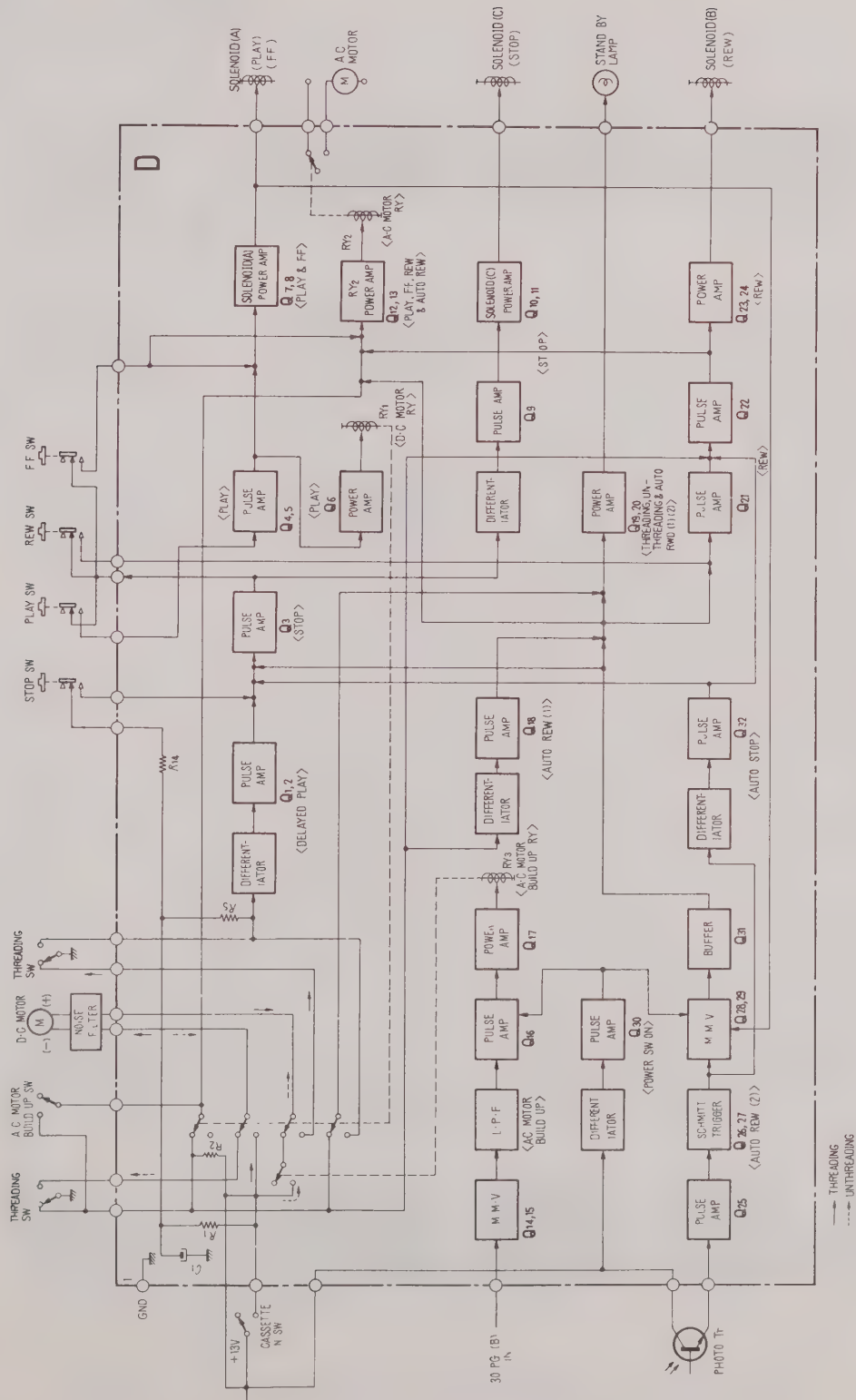
Note: All reference number of components in this diagram are in 2000 series.

— S Board —



Note: All reference number of components in this diagram are in 8000 series.

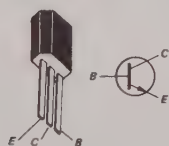
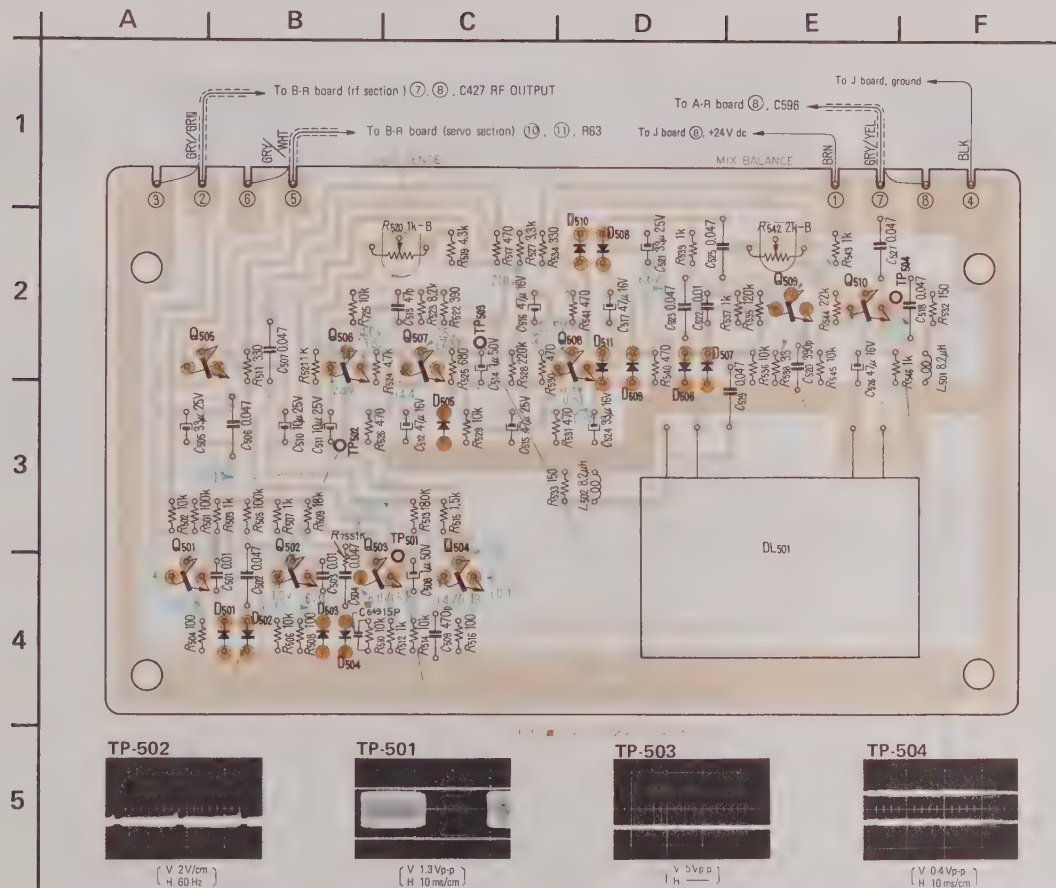
11-9. BLOCK DIAGRAM — D Board —



Note: All reference numbers of components in this diagram are in 4000 series.

11-10. MOUNTING DIAGRAM

— K Board —

2SC634A
2SC403B

1S2144A



RD13A

Note: All reference numbers of components or test points in this diagram are in 1000 series.

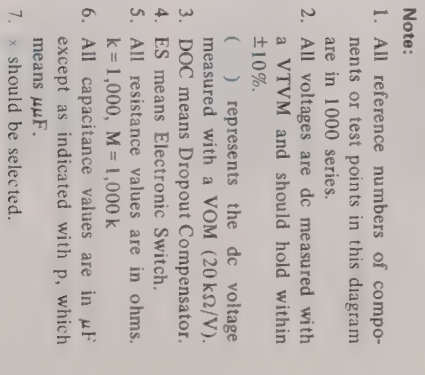
D501 }
D502 } 1S2144A
D503 }
D504 }
D505 } RD13A
D506 }
D507 }
D508 } 1S2144A
D509 }
D510 }
D511 }

Q501 }
Q502 } 2SC403B
Q503 }
Q504 }
Q505 } 2SC403B
Q506 }
Q507 } 2SC634A
Q508 }
Q509 } 2SC403B
Q510 }

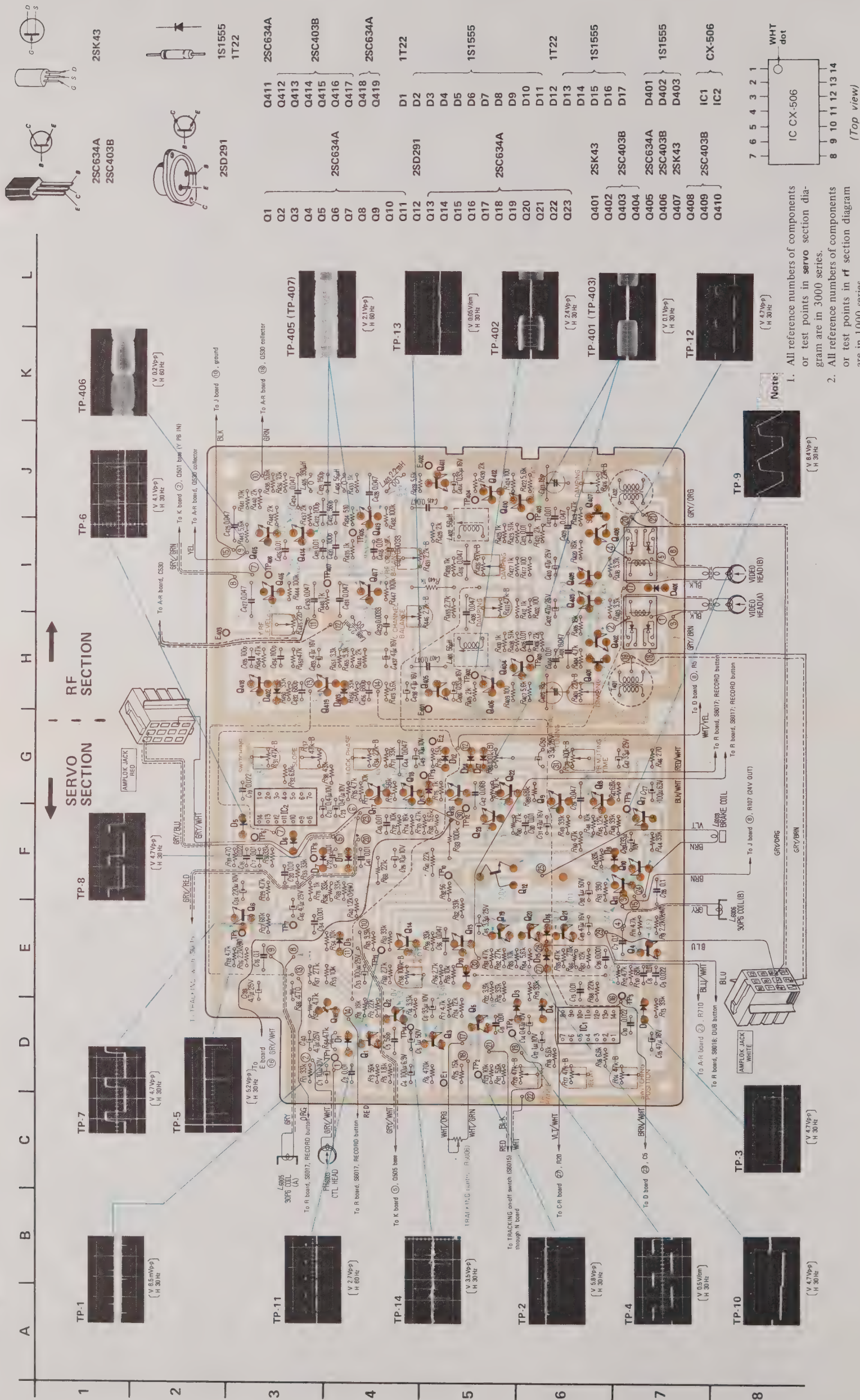


11-11

- A-R, B-R (RF) and K Board -

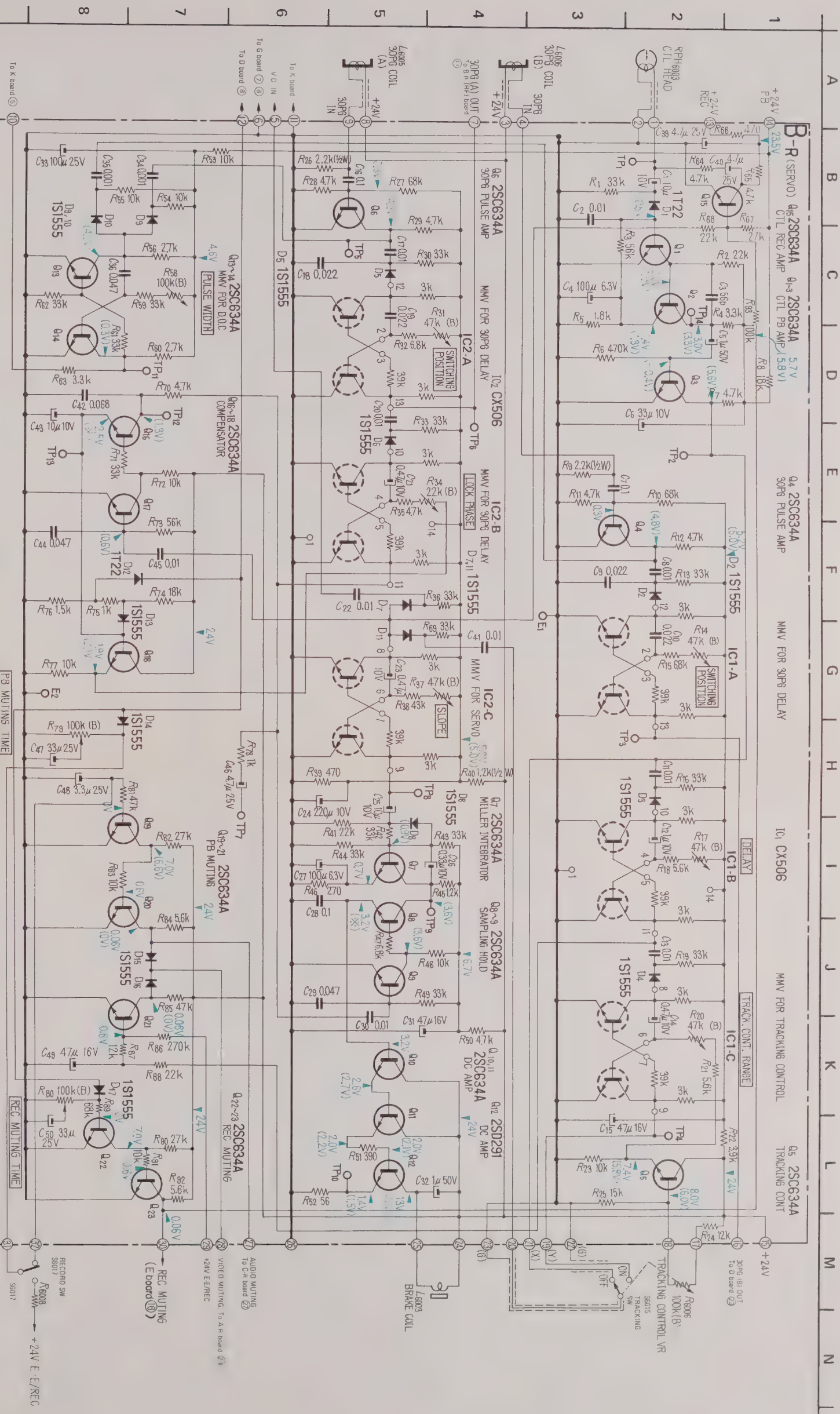


11-13. MOUNTING DIAGRAM
— B-R Board —



11-14. MOUNTING DIAGRAM

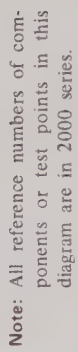
— B-R (SERVO) Board —



Note:

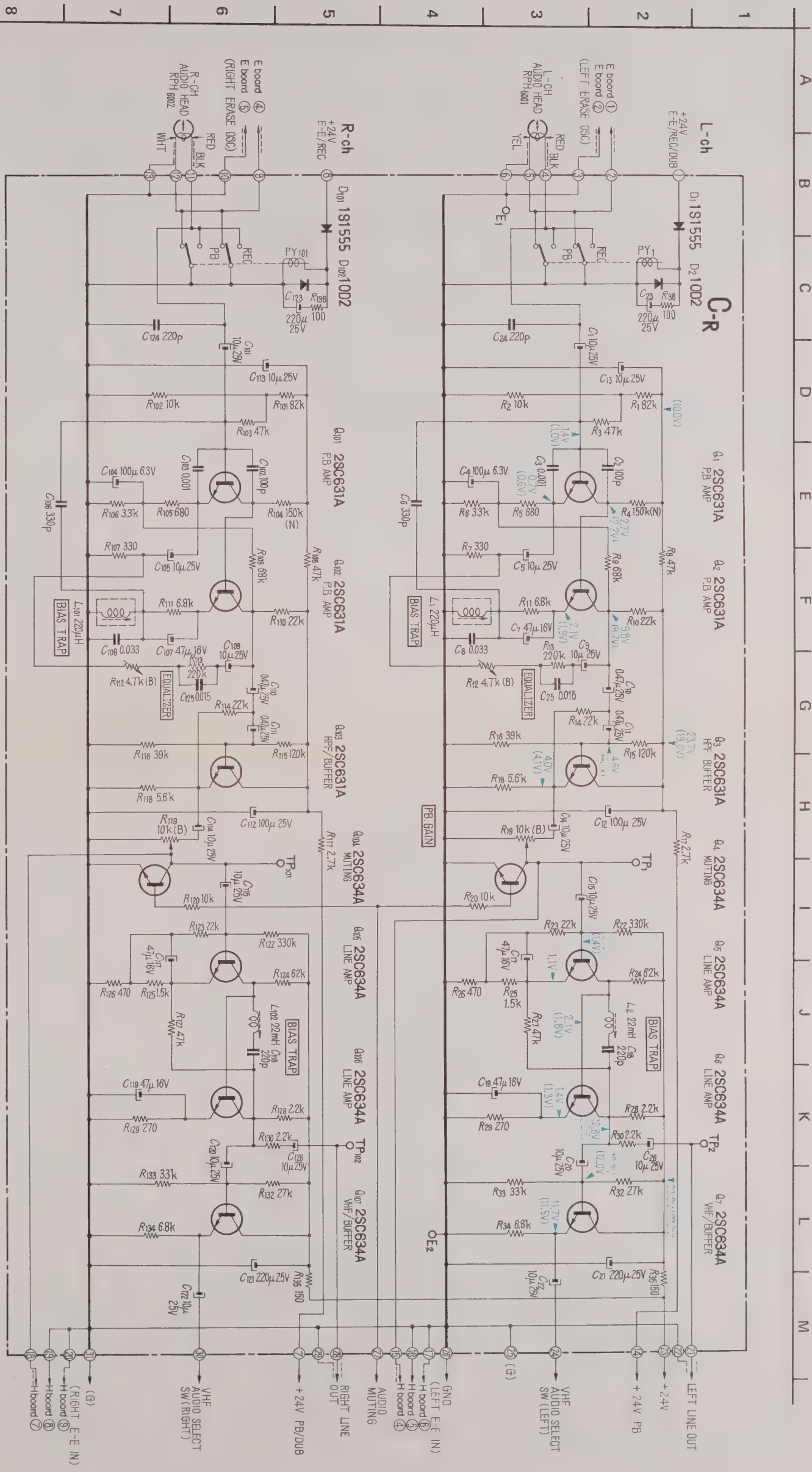
- 1. All reference numbers of components or test points in this diagram are in 3,000 series.
- 2. All voltages are dc measured with a VTVM and should hold within $\pm 10\%$.
() represents the dc voltage measured with a VOM (20 k Ω /V).
- 3. All resistance values are in ohms. k = 1,000, M = 1,000 k
- 4. All capacitance values are in μ F except as indicated with p, which means μ F.

Note: See Supplement 1 for Serial No. 11,001 and later.



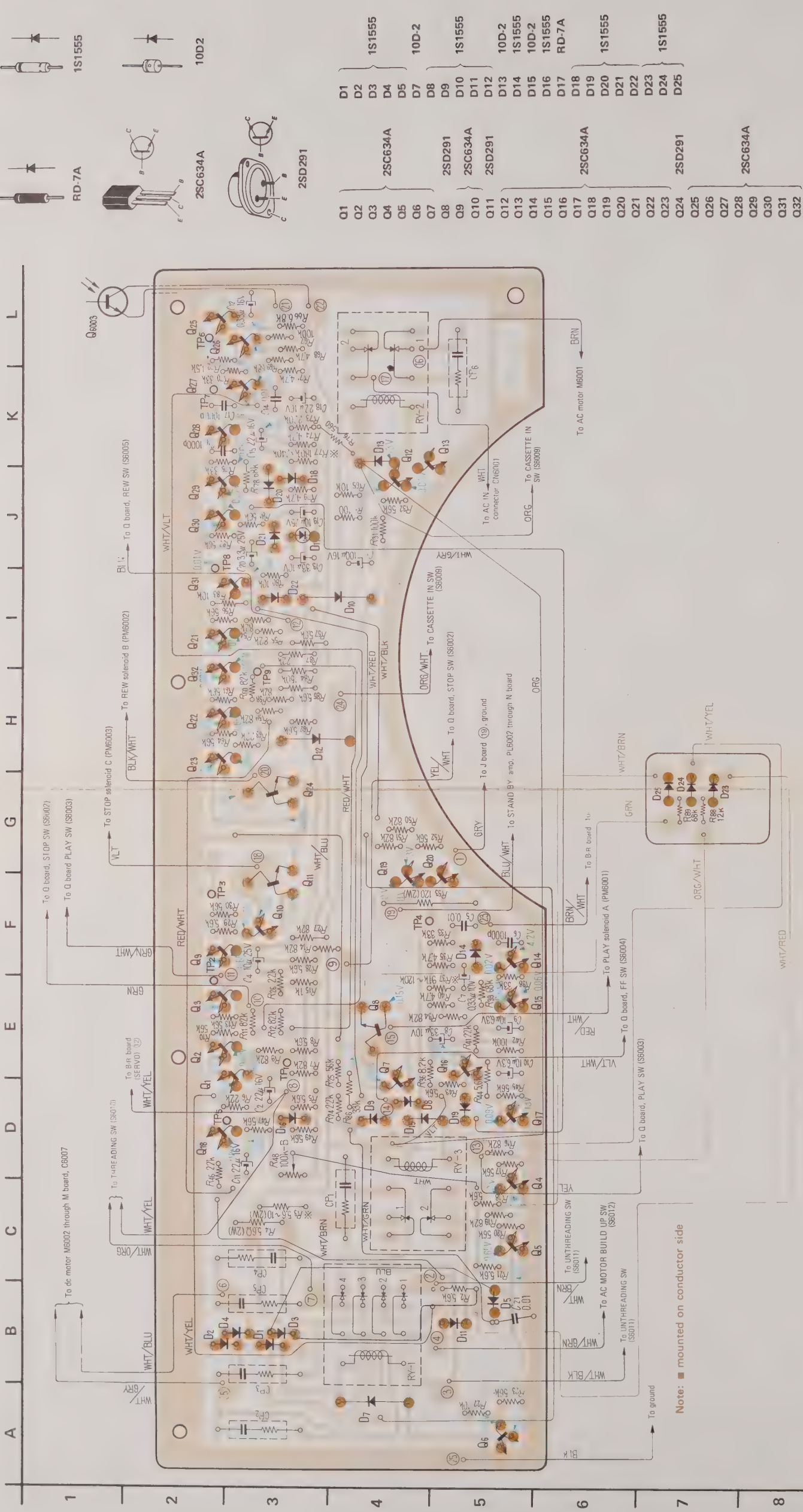
To N board, R6004 and then,
to VHF AUDIO SELECT SW (S6013)

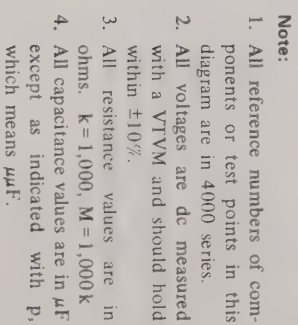
11-16. SCHEMATIC DIAGRAM
— C-R Board — (Serial No. up to 11,000) Note: See Supplement 1 for Serial No. 11,001 and later.



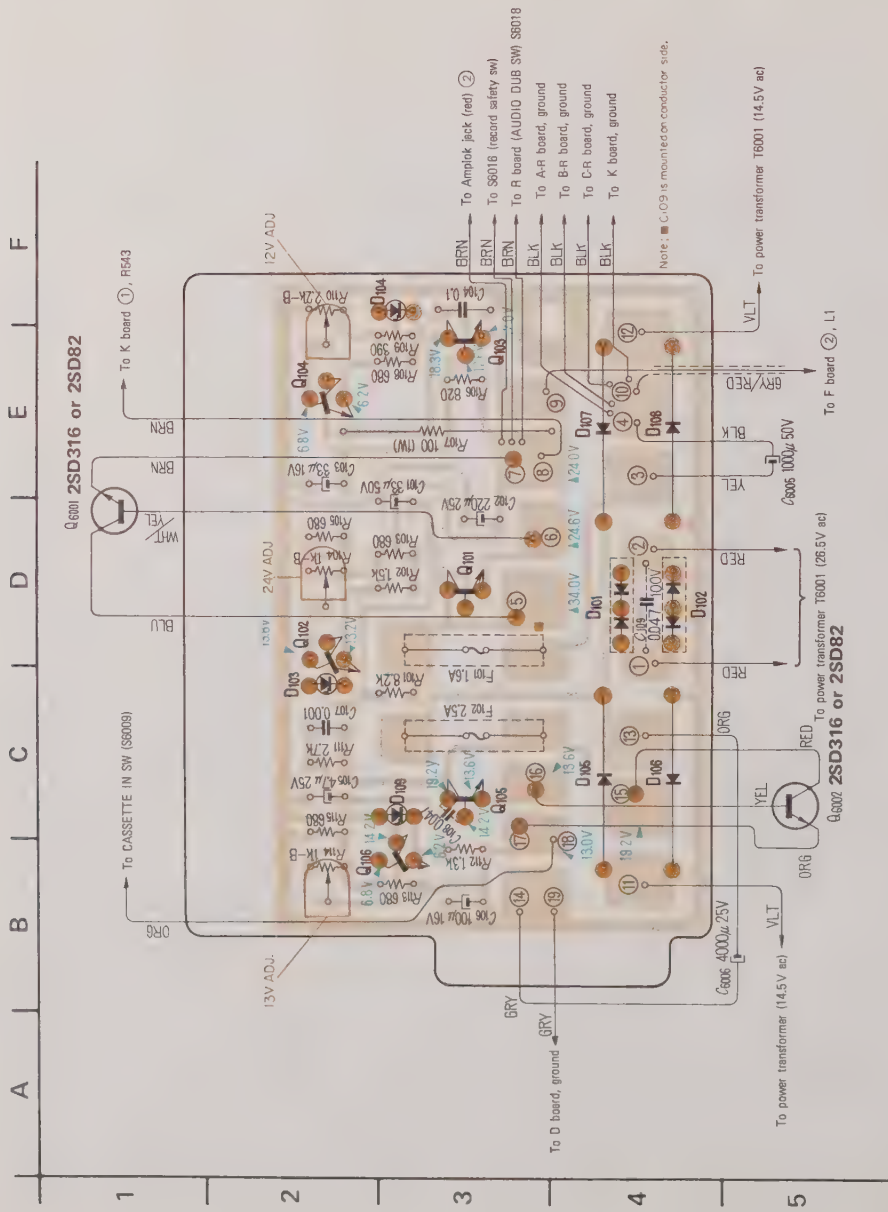
- Note:
1. All reference numbers of components or test points in this diagram are in 2000 series.
 2. All voltages are dc measured with a VTVM and should hold within $\pm 10\%$.
() represents the dc voltage measured with a VOM (20 k Ω /V).
 3. R-CH voltages are same as L-CH.

11-17. MOUNTING DIAGRAM
— D and Y Board — (Serial No. up to 10,400) Note: See Supplement 1 for Serial No. 10,401 and later.

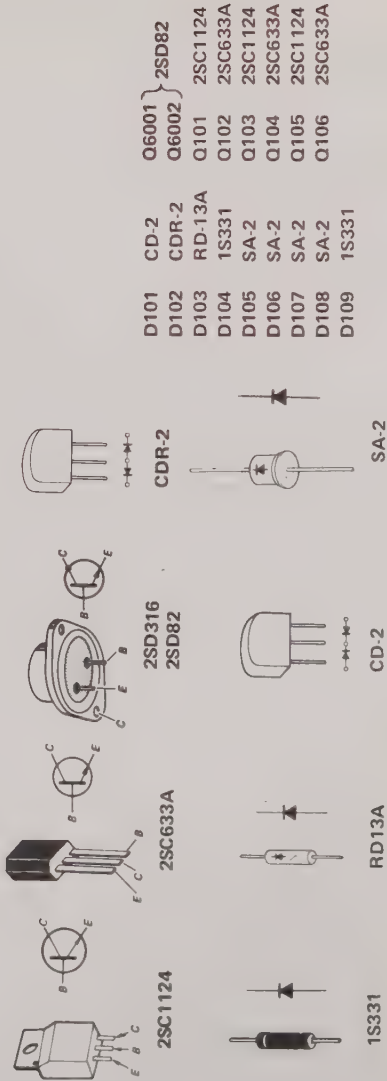




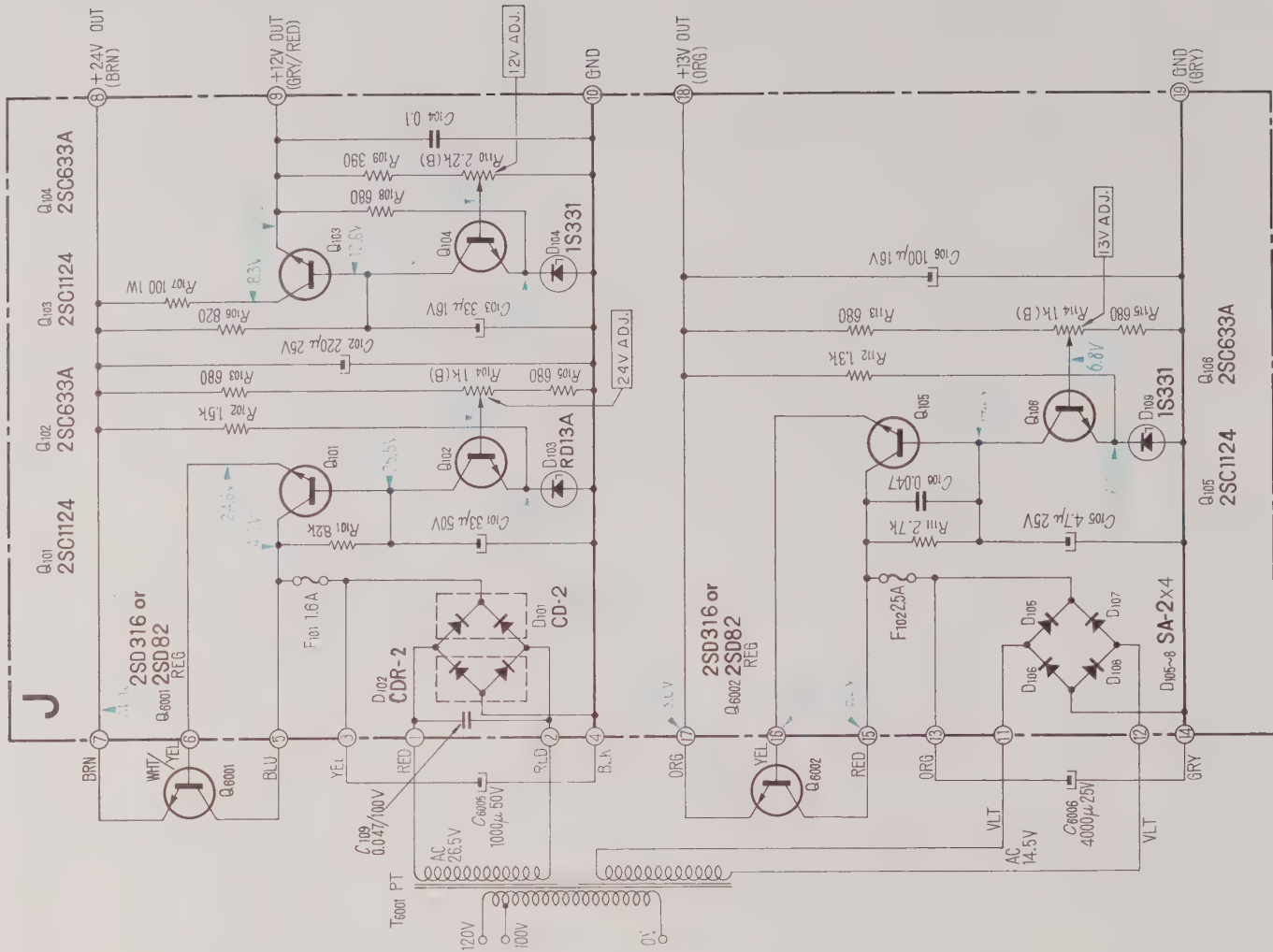
11-19. MOUNTING DIAGRAM
— J Board —



Note: All reference numbers of components or test points in this diagram are in 6000 series.



11-20. SCHEMATIC DIAGRAM
— J Board —



- Note:
1. All reference numbers of components or test points in this diagram are in 6000 series.
 2. All voltages are dc measured with a VTVM and should hold within $\pm 10\%$.
 3. All resistance values are in ohms, k = 1,000, M = 1,000 k.
 4. All capacitance values are in μF except as indicated with p, which means μF .

11-21. MOUNTING DIAGRAM

— F Board —

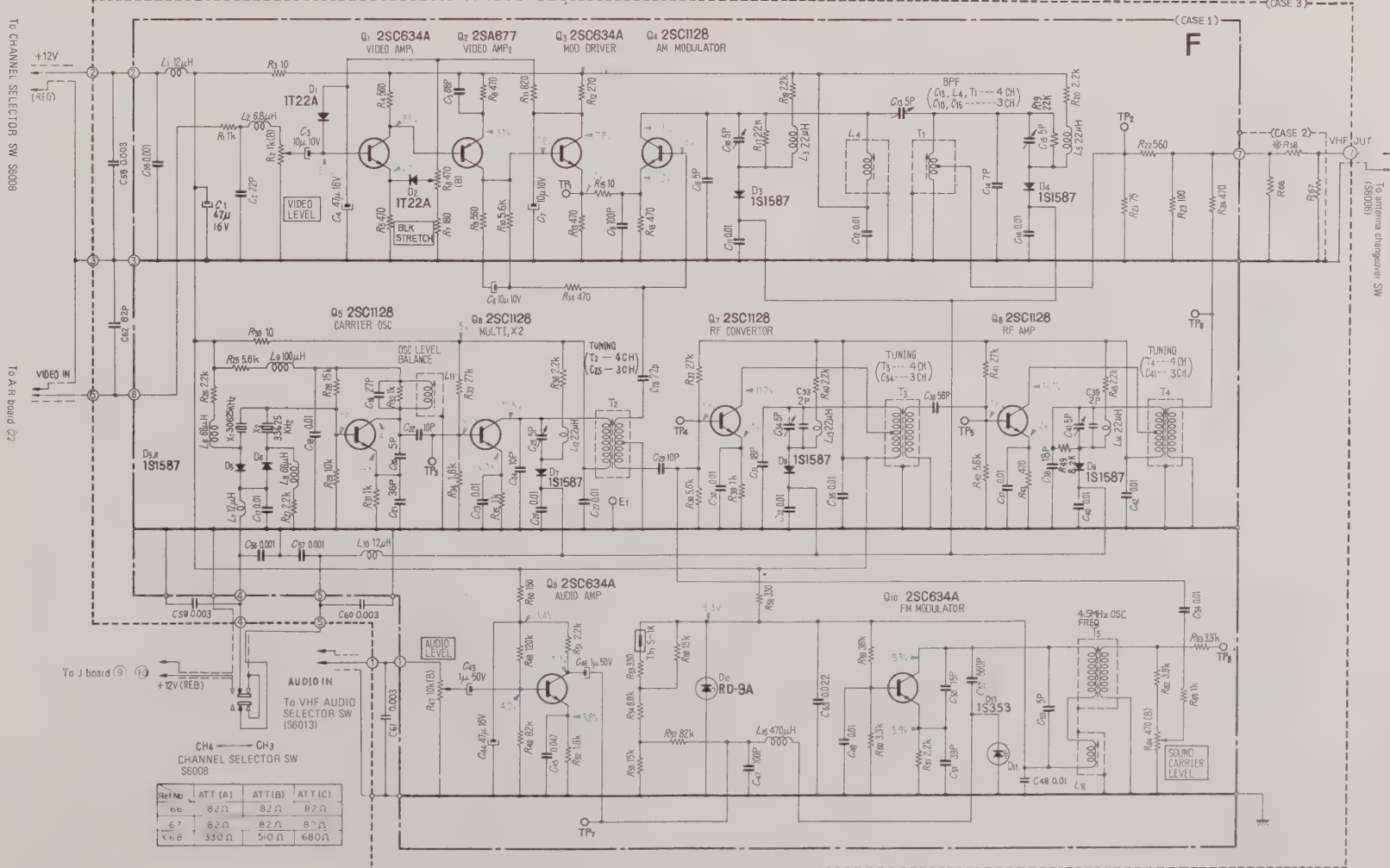


Note: All reference numbers of components or test points in this diagram are in 5000 series.

- | | | | | | | |
|---------|--------|---------|-----|---------|-----|-------|
| 2SC634A | 2SA677 | 2SC1128 | Q1 | 2SC634A | D1 | 1T22A |
| | | | Q2 | 2SA677 | D2 | |
| | | | Q3 | 2SC634A | D3 | |
| | | | Q4 | | D4 | |
| | | | Q5 | 2SC1128 | D5 | |
| | | | Q6 | | D6 | |
| | | | Q7 | | D7 | |
| | | | Q8 | | D8 | |
| | | | Q9 | 2SC634A | D9 | |
| | | | Q10 | | D10 | |
| | | | | | D11 | |
- 1T22A
1S1587
1S353
- RD-9A

CAUTION
Never attempt any repair work on F board except for semiconductors (except Q10, D10 and D11) and resistors. Send the unit to the Factory Service Center for a complete alignment or adjustment.

11-22. SCHEMATIC DIAGRAM — F Board —

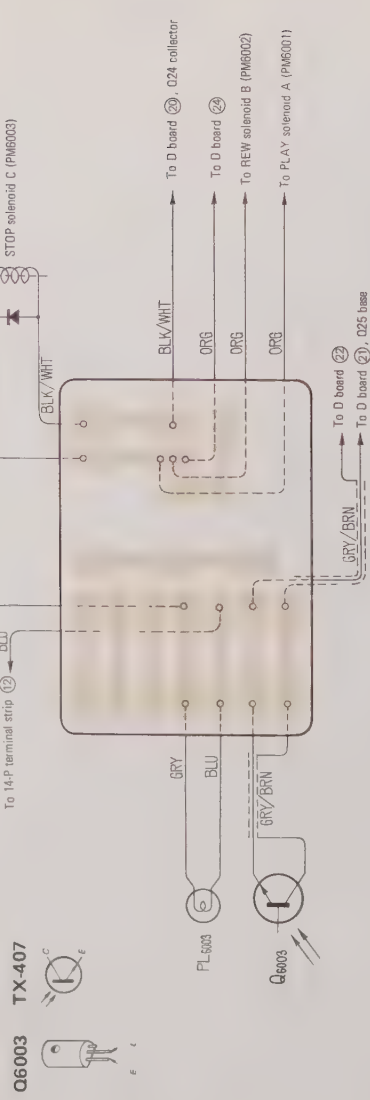


Note:

1. All reference numbers of components or test points in this diagram are in 5000 series.
2. All voltages are dc measured with a VTVM and should hold within $\pm 10\%$.
3. All resistance values are in ohms. k=1,000,
4. All capacitance values are in μF except as indicated with p, which means μF .

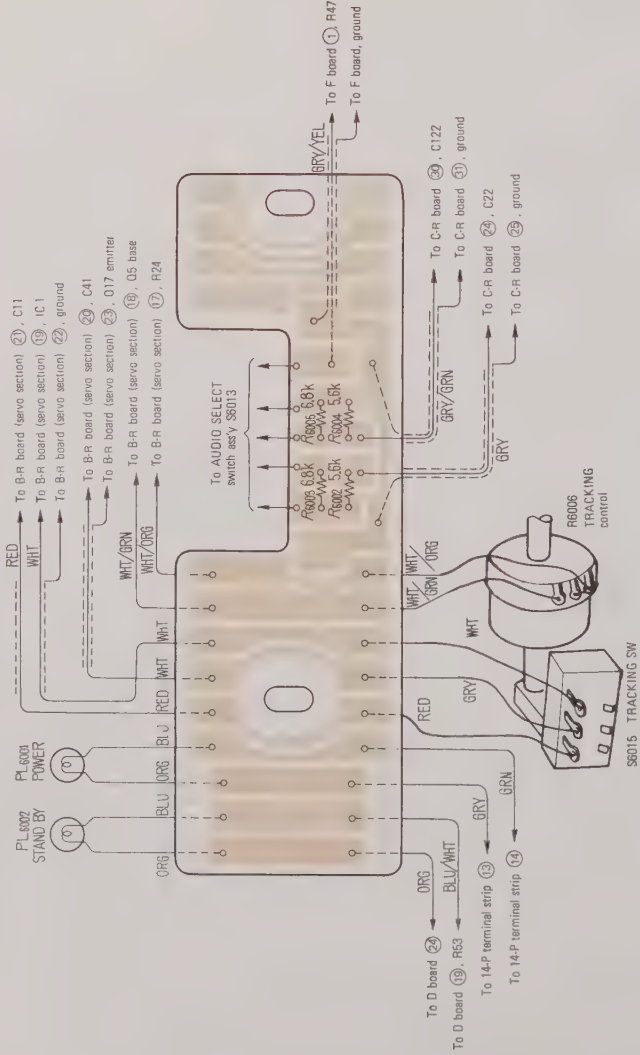
ATT (A)	ATT (B)	ATT (C)
82 Ω	82 Ω	82 Ω
82 Ω	82 Ω	82 Ω
330 Ω	50 Ω	680 Ω

11-23. MOUNTING DIAGRAM
— U, N and M Board —

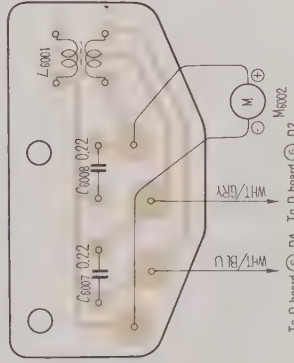


N Board (Serial No. up to 11,000)

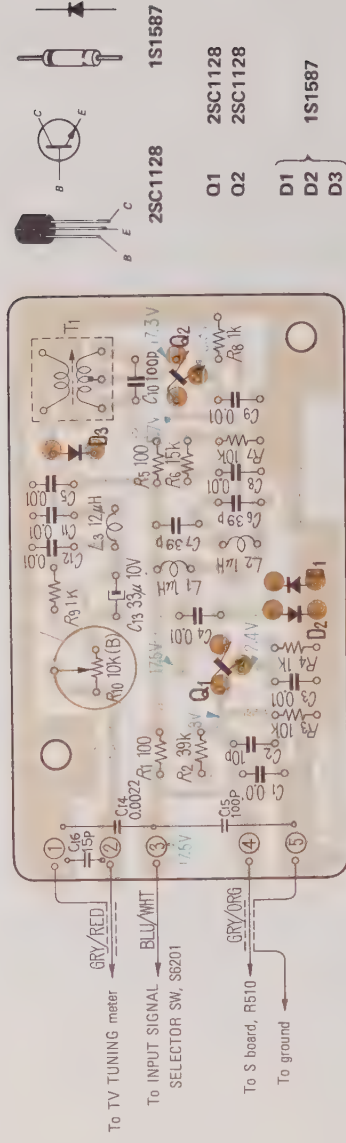
Note: See Supplement for Serial No. 11,001 and later.



M Board (Serial No. up to 11,240) Note: See Supplement 1 for Serial No. 11,241 and later.

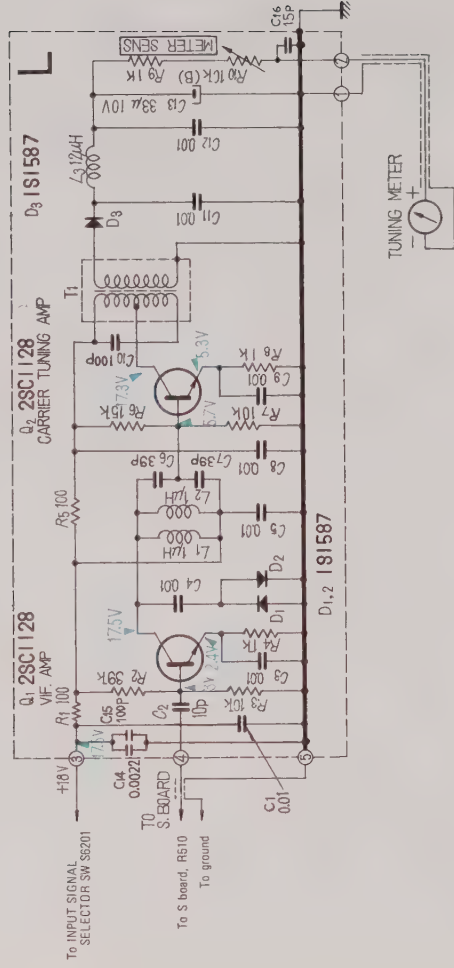


11-24. MOUNTING DIAGRAM AND SCHEMATIC DIAGRAM
- L Board -



Note: All reference numbers of component or test points in this diagram are in 7000 series.

— L Board —

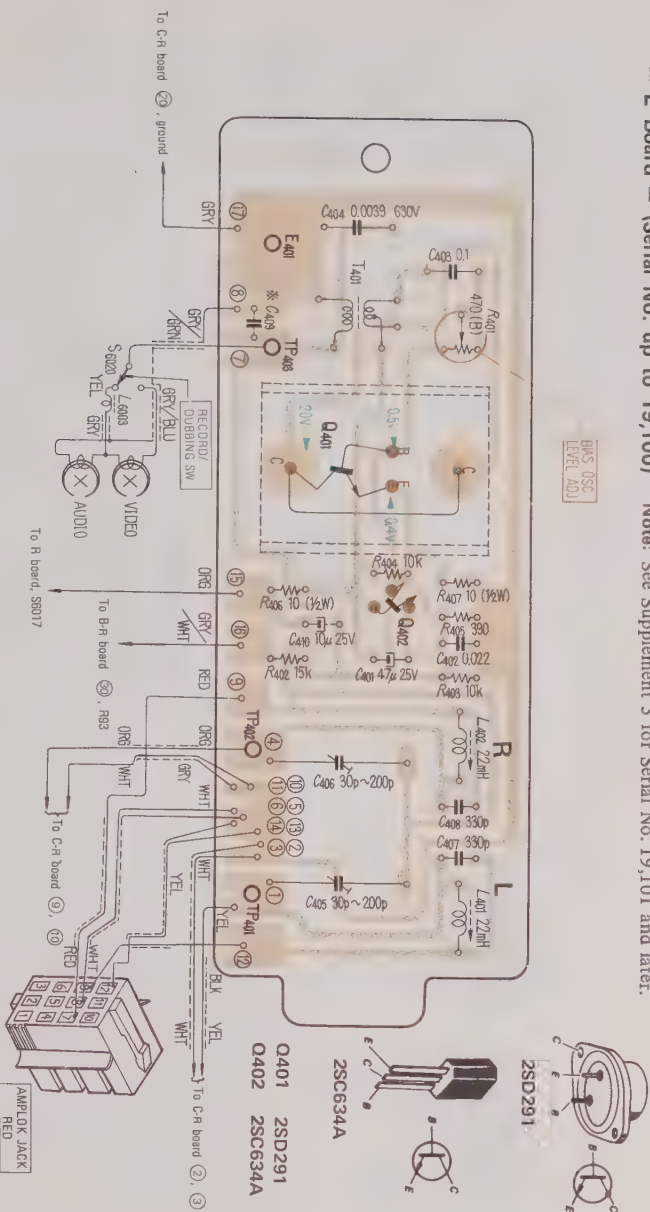


Note:

1. All reference numbers of component in this diagram are in 7000 series.
2. All voltages are dc measured with a VOM (20 k Ω /V) and should hold within $\pm 10\%$.
3. All resistance values are in ohms. K = 1,000,
4. All capacitance values are in μ F except as indicated with p, which means μ F.

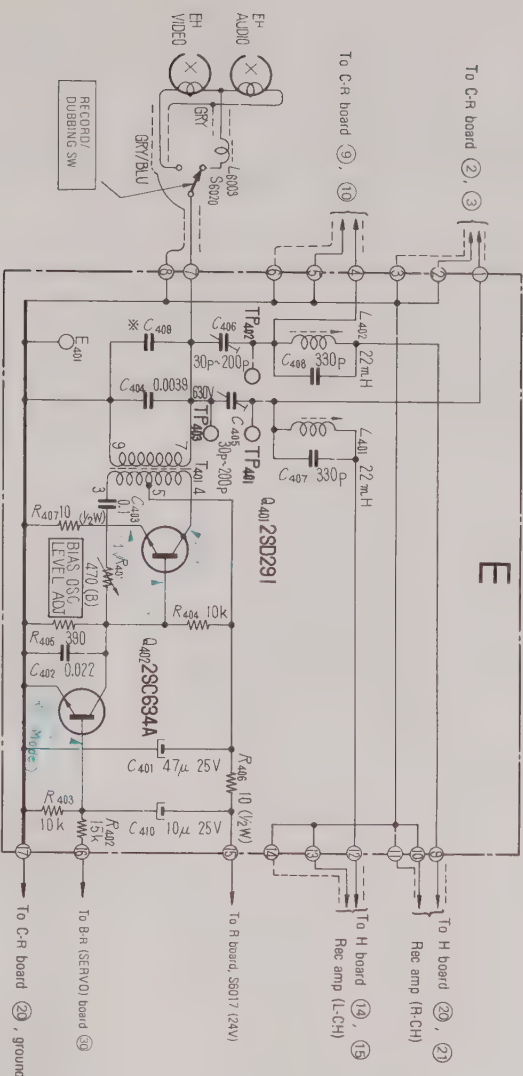
11-25. MOUNTING DIAGRAM AND SCHEMATIC DIAGRAM

— E Board — (Serial No. up to 19,100) Note: See Supplement 3 for Serial No. 19,101 and later.



Note: All reference numbers of component or test points in this diagram are in 2000 series.

— E Board — (Serial No. up to 19,100) Note: See Supplement 3 for Serial No. 19,101 and later.

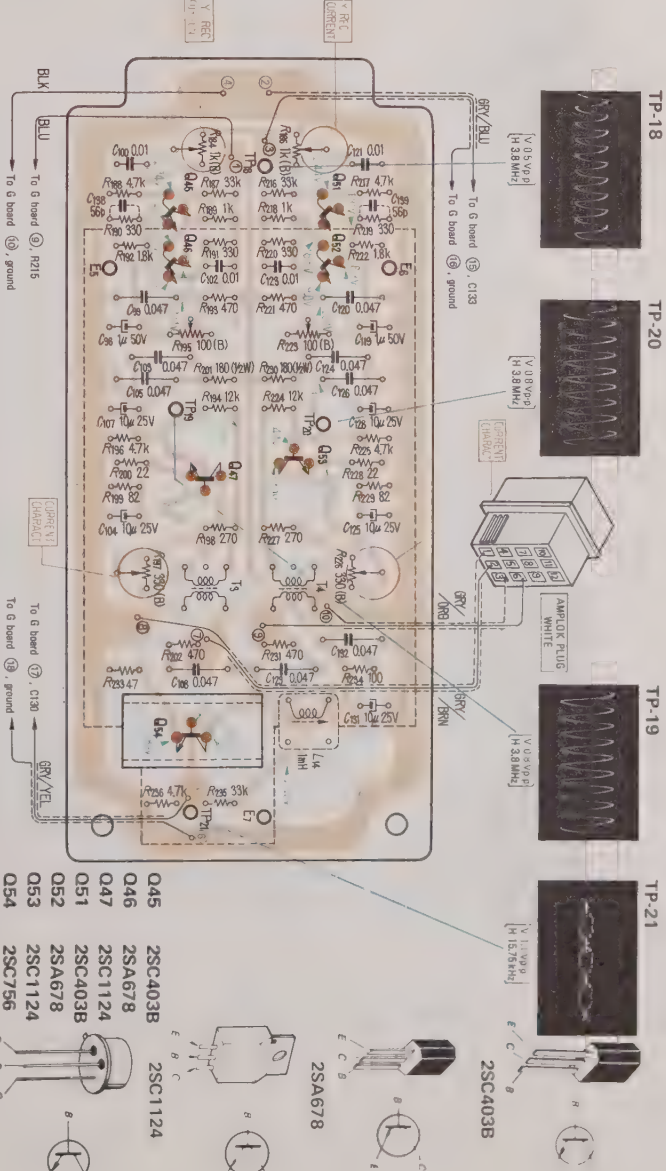


Note:

1. All reference numbers of component in this diagram are in 2000 series.
2. All voltages are dc measured with a VOM (20 k Ω /V) and should hold within $\pm 10\%$.
3. All resistance values are in ohms, K = 1,000, M = 1,000 k
4. All capacitance values are in μ F except as indicated with p, which means μ F.

11-26. MOUNTING DIAGRAM — V Board and T Board —

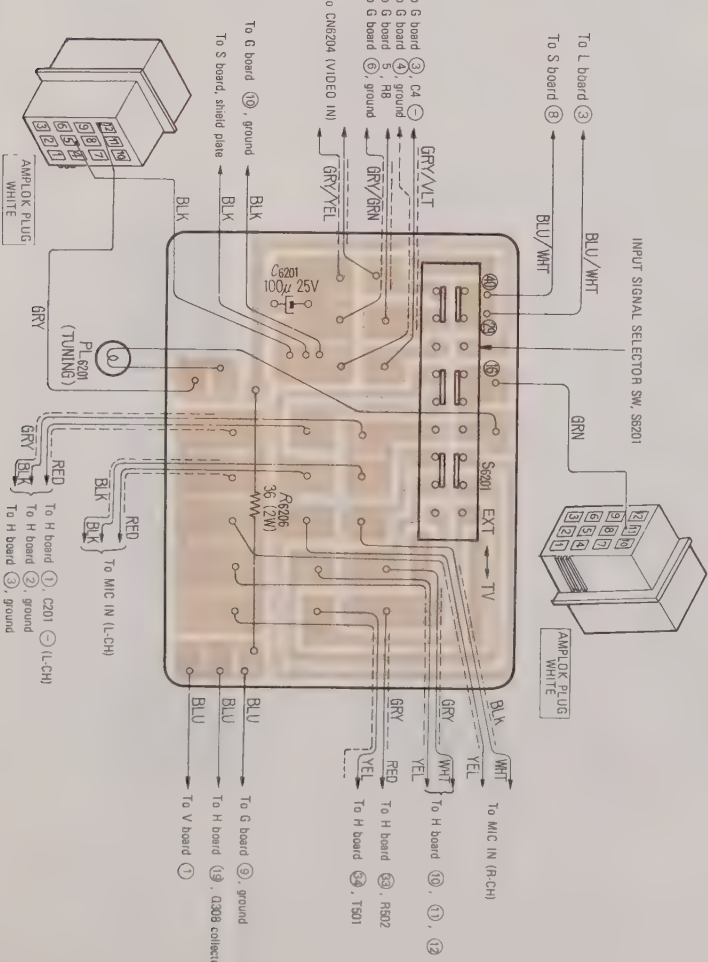
— V Board —



Note: All reference numbers of component in this diagram are in 1000 series.

— T Board —

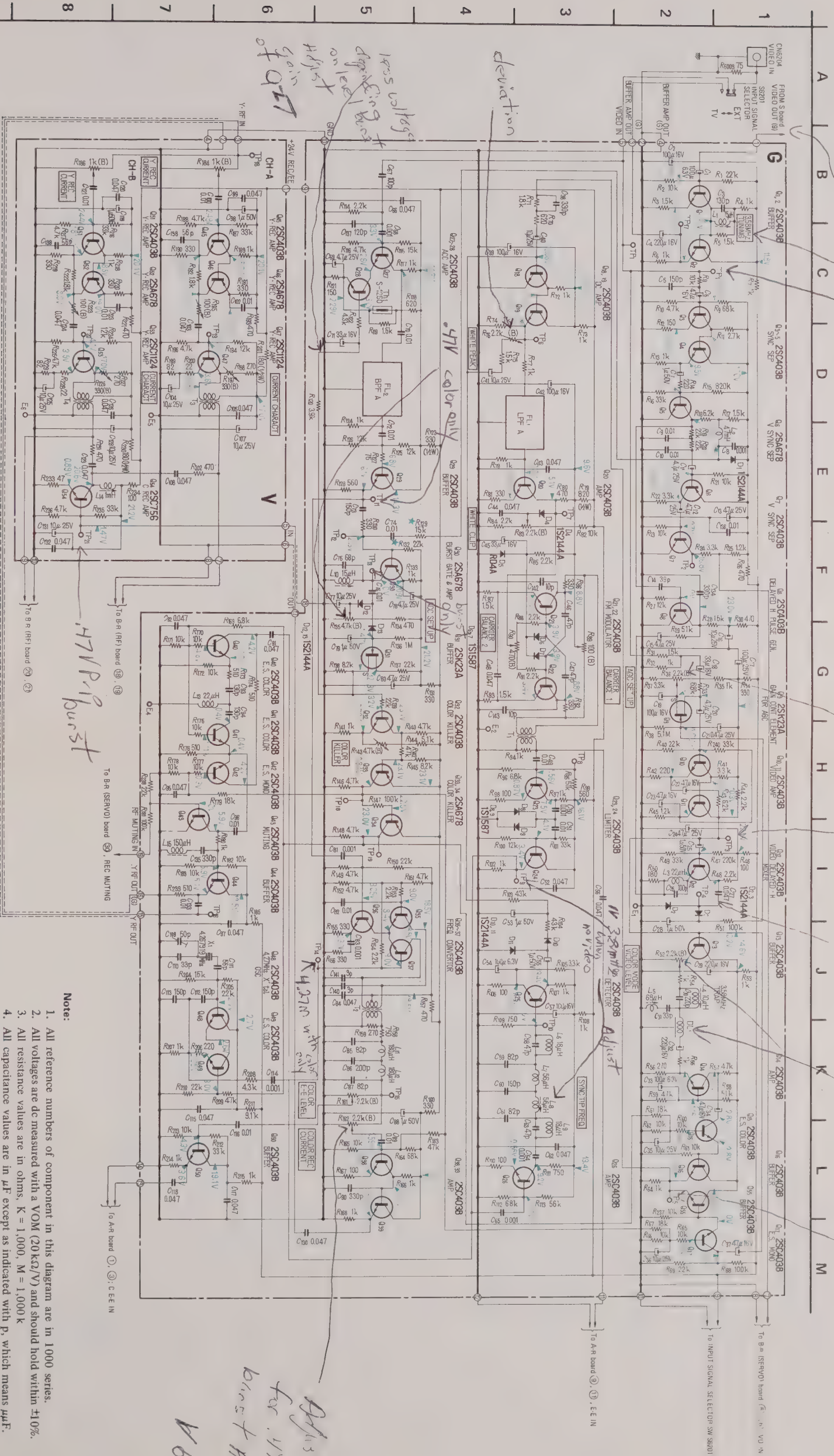
Note: See supplement 1 for WIRING modification.





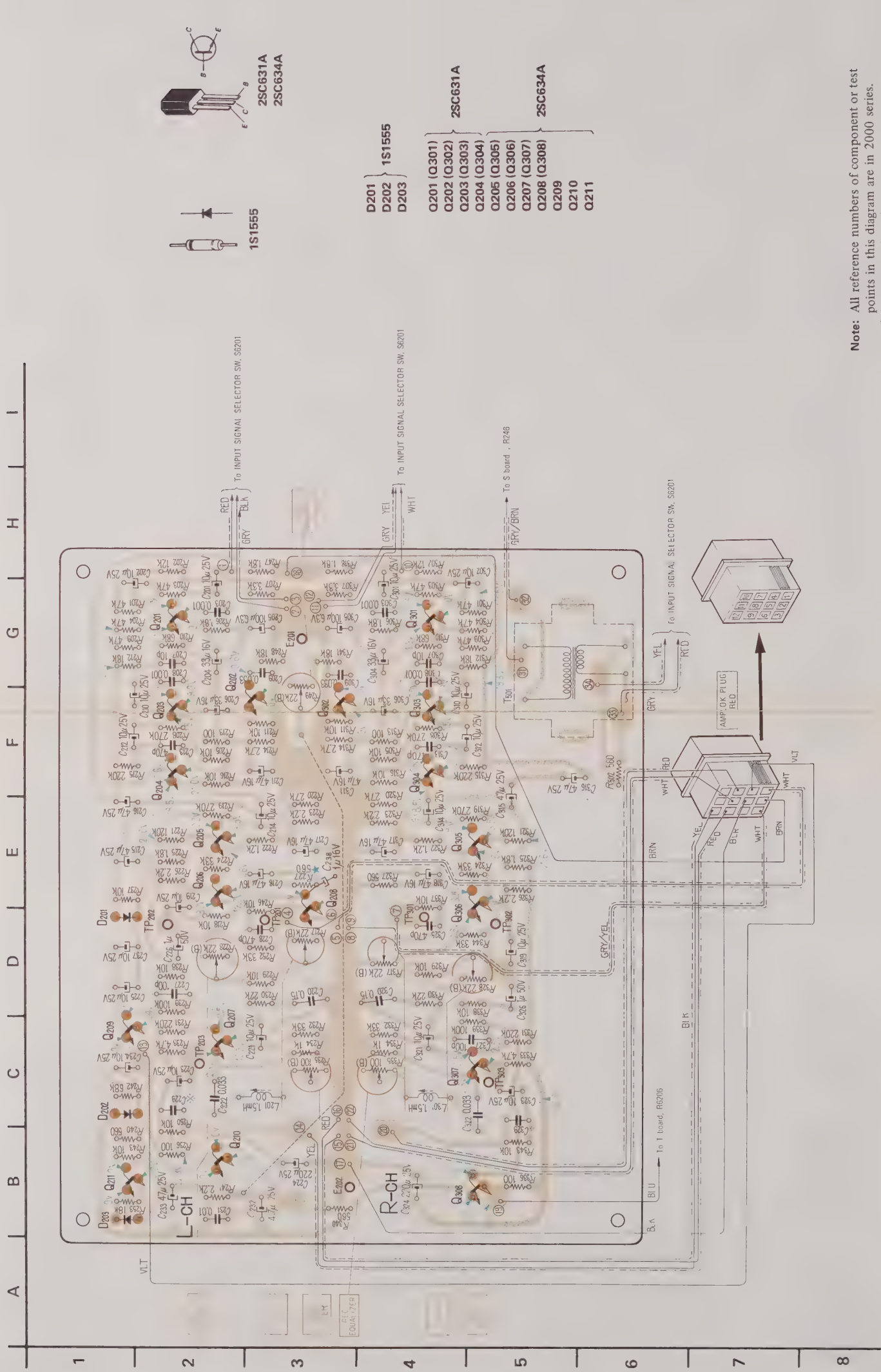
- ★ R129 15k → 1.5k (Serial No. 13,001 and later)
★ R132 22k → 470k (Serial No. 13,001 and later)
★ C8 0.001 → 0.0018 (Serial No. 11,851 and later)

— G Board and V Board —



1. All reference numbers of component in this diagram are in 1 000 series.
 2. All voltages are dc measured with a VOM (20 k Ω /V) and should hold within $\pm 10\%$.
 3. All resistance values are in ohms, K = 1,000, M = 1,000 k
 4. All capacitance values are in μ F except as indicated with p, which means μ F.
- * R129 15 k $\rightarrow$ 1.5 k (Serial No. 13,001 and later)
* R132 22 k $\rightarrow$ 470 k (Serial No. 13,001 and later)
* C8 0.001 $\rightarrow$ 0.0018 (Serial No. 11,851 and later)

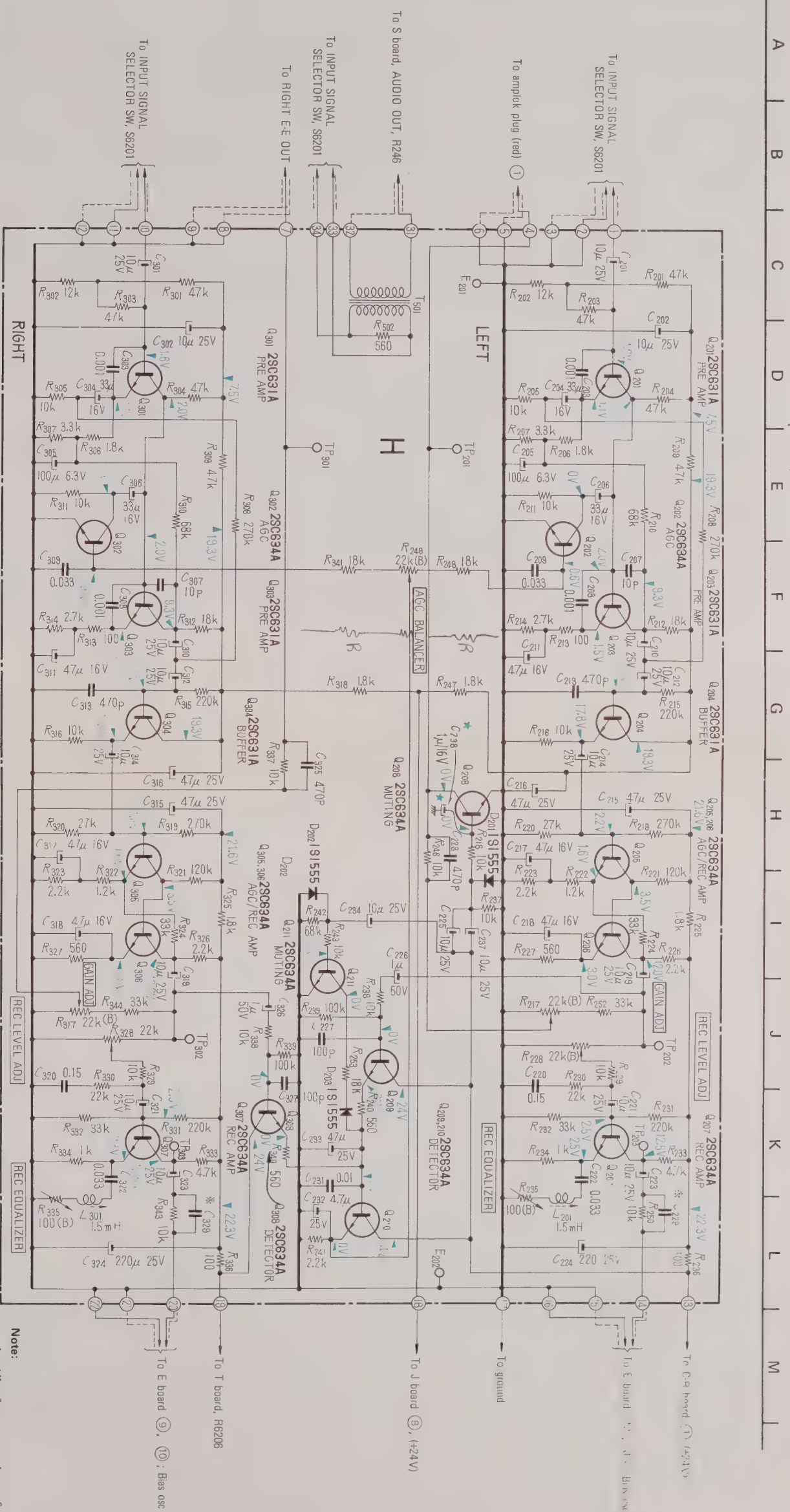
11-29. MOUNTING DIAGRAM
— H Board —



11-30. SCHEMATIC DIAGRAM

— H Board —

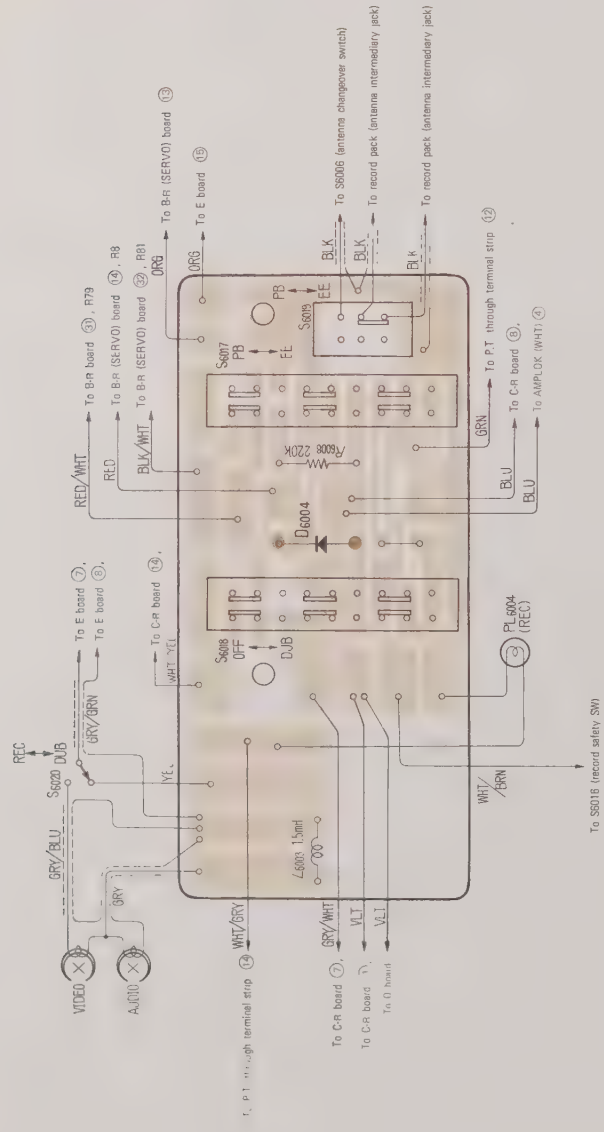
for manual gain channel
 put oscillator in 19 or 19Kc so it out of band pass
 the level for Audio gain



Note:

1. All reference numbers of component in this diagram are in 2000 series.
 2. All voltages are dc measured with a VOM (20k Ω /V) and should hold within $\pm 10\%$.
 3. All resistance values are in ohms. K = 1,000, M = 1,000K.
 4. All capacitance values are in μ F except as indicated with p, which means pF.
- ★ C238 is mounted for the set Serial No. 13,401 and later.

11-31. MOUNTING DIAGRAM
— R Board —

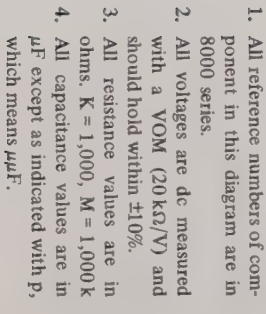


11-32. MOUNTING DIAGRAM – S Board –

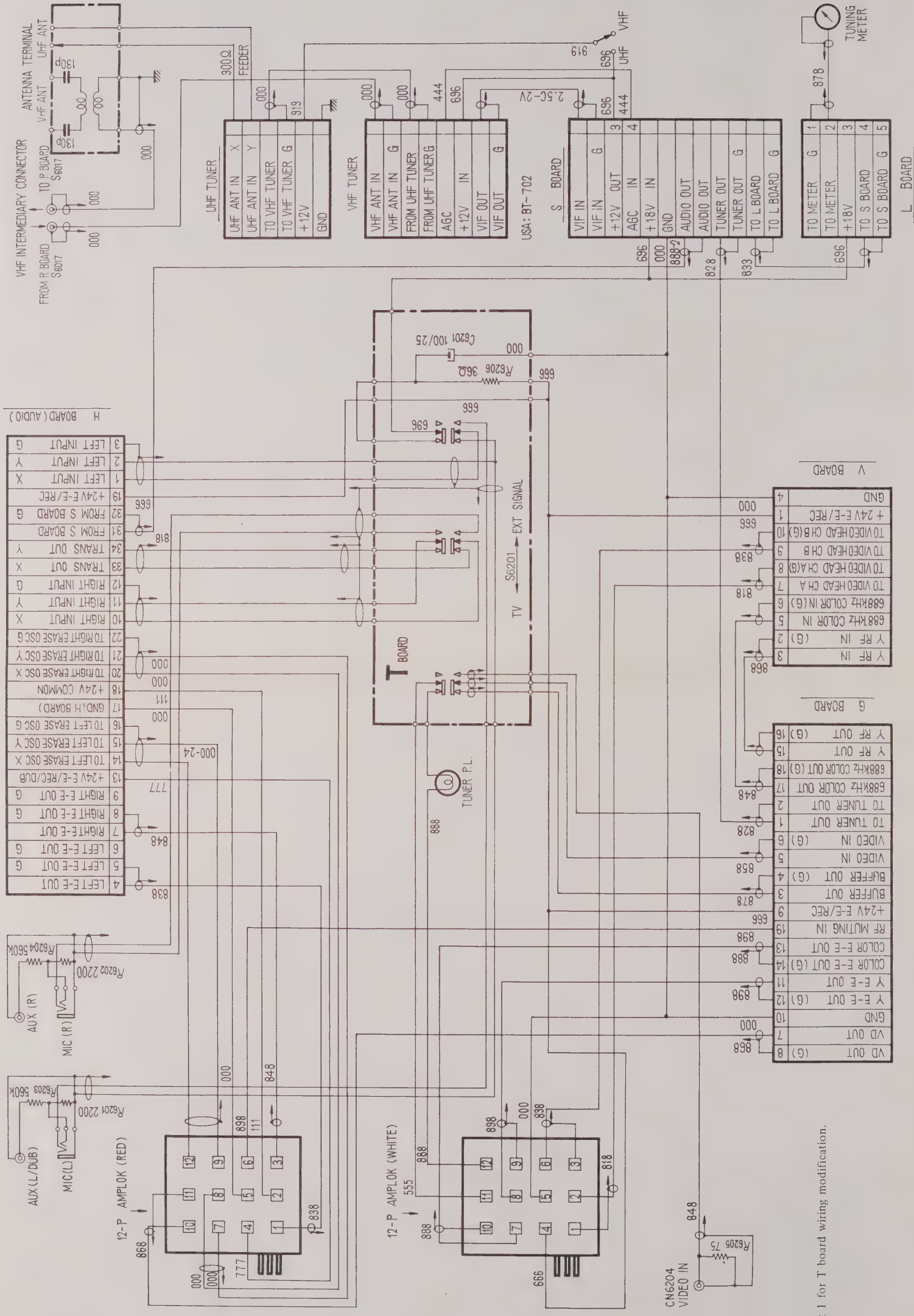


Note: All reference numbers of component or test points in this diagram are in 8000 series.
★ Due to T board wiring change. See Supplement 1, page 10.

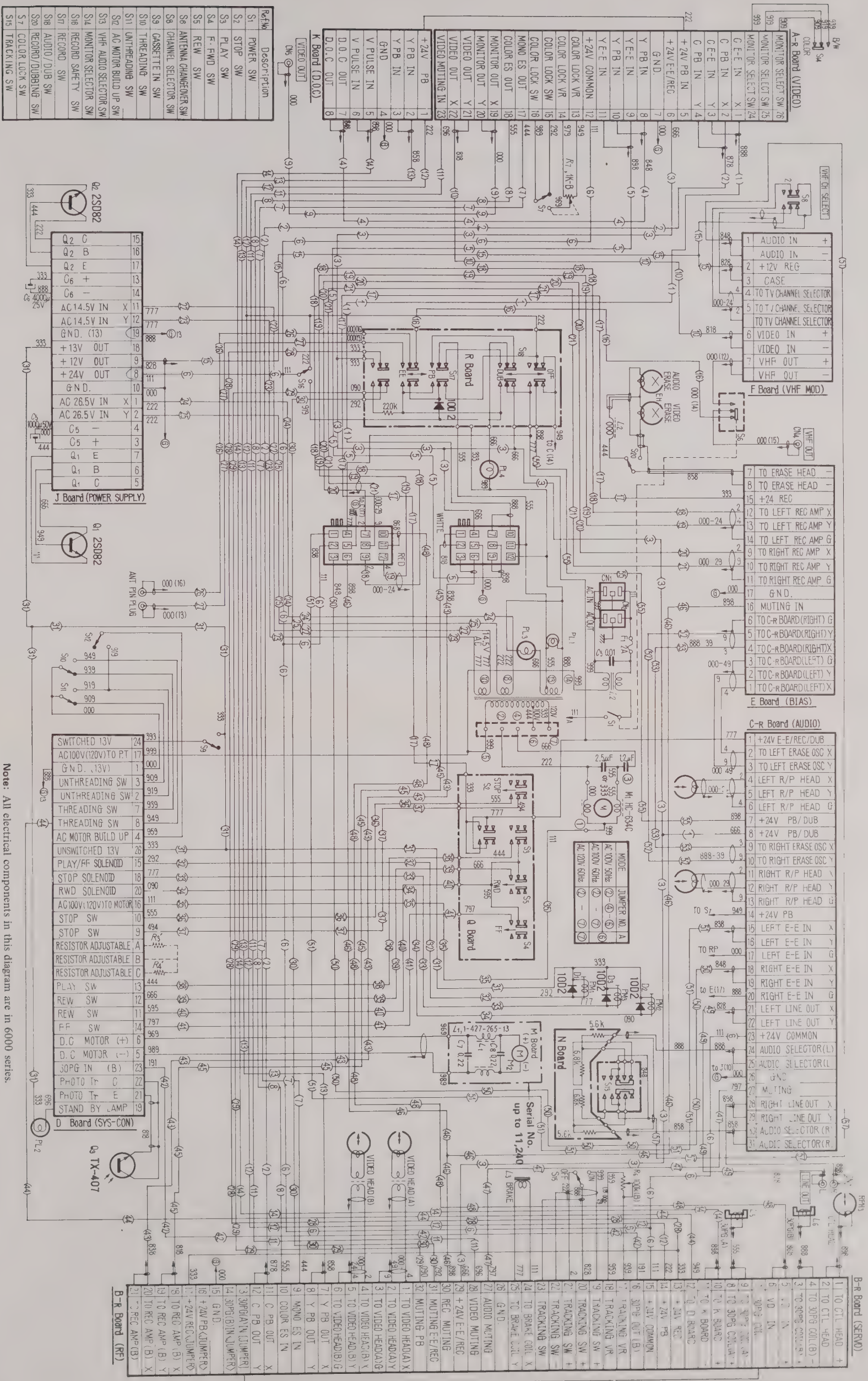
D201	1T261	Q201	2SC1129	Q207	2SC633A	IC201	M-5142P
D202	1T40	Q202		Q208			
D203	ZB1-11	Q203	2SC1128	Q209			
D204	1T261	Q204	2SC633A	Q210			
D205	1T40	Q205	2SA611 or 2SA564A				
		Q206	2SA610 or 2SA564A				



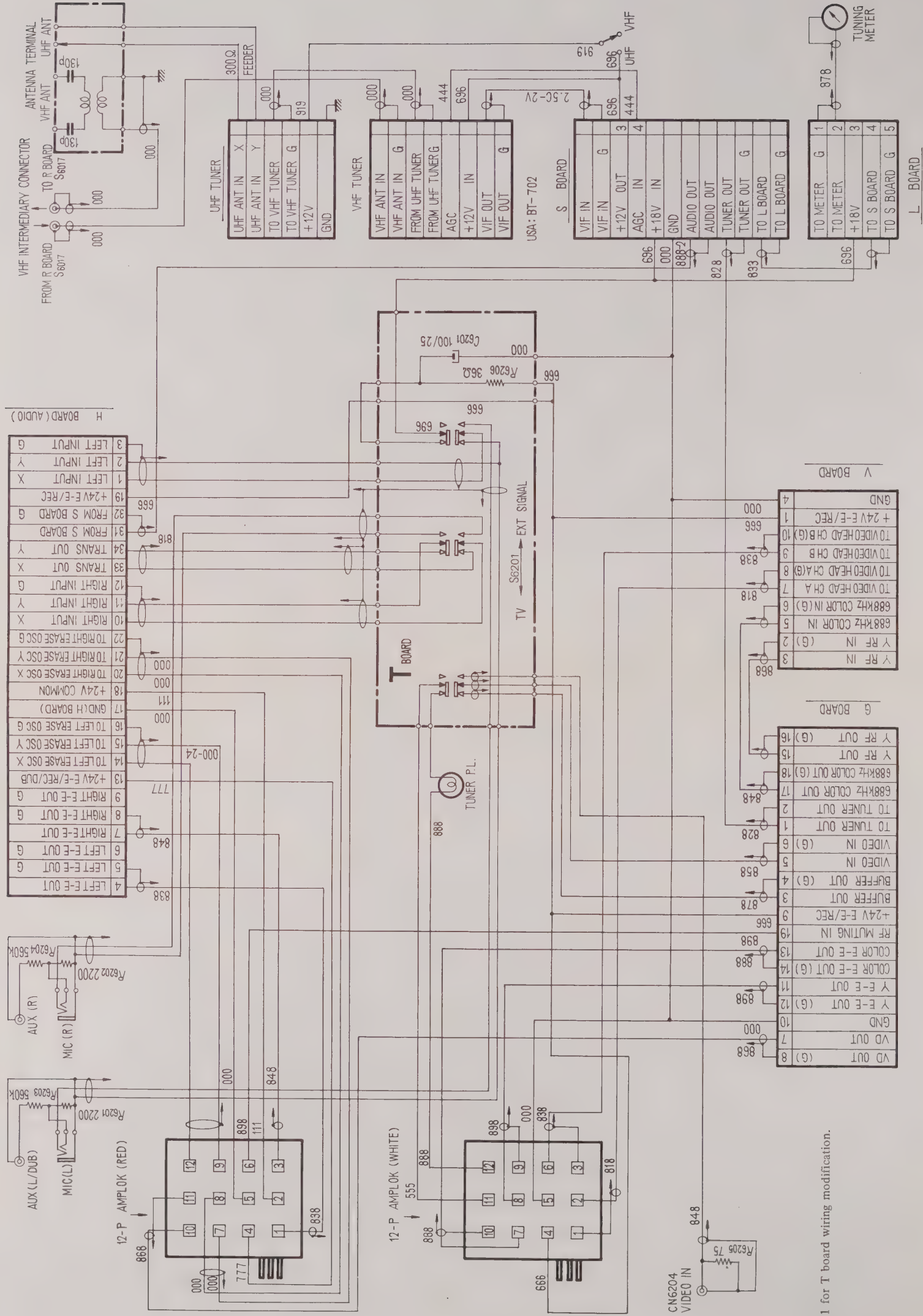
11-34. FRAME WIRING DIAGRAM (1) -- Record Pack Section --



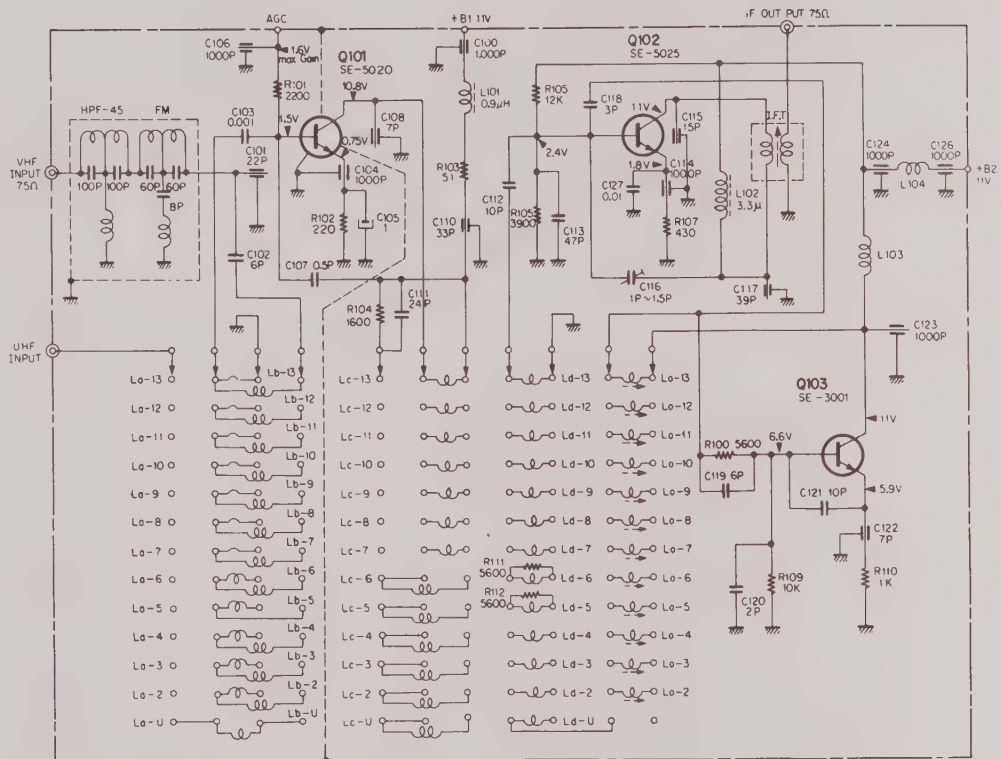
Note: See supplement 1 for T board wiring modification.



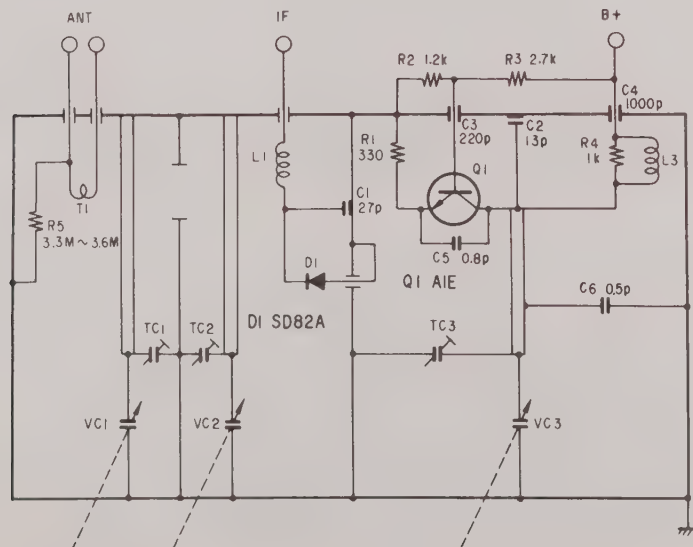
11-34. FRAME WIRING DIAGRAM (1) — Record Pack Section —



11-36. SCHEMATIC DIAGRAM – VHF Tuner and UHF Tuner –



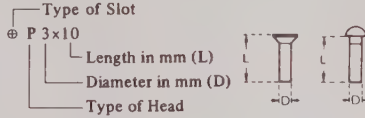
– UHF Tuner –



SECTION 12 EXPLODED VIEWS

12-1. HARDWARE

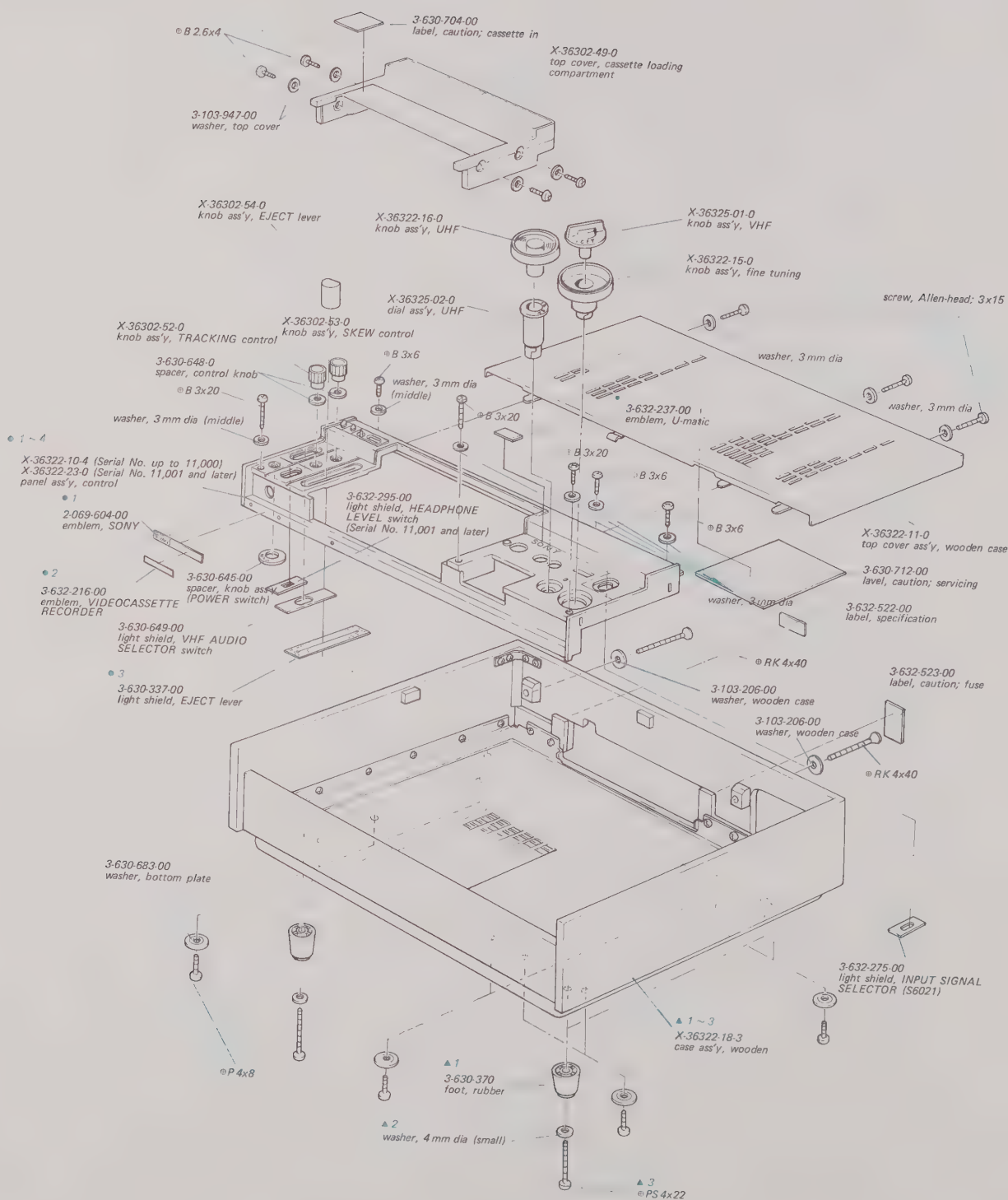
- (1) The following chart will help you to decipher the hardware codes given in the exploded views.

P - Pan Head Screw		SC Set Screw	
PS - Pan Head Screw with Spring Washer		E - Retaining Ring (E Washer)	
K - Flat Countersunk Head Screw		W - Washer	
B - Binding Head Screw		SW - Spring Washer	
RK - Oval Countersunk Head Screw		LW - Lock Washer	
T - Truss Head Screw		N - Nut	
R - Round Head Screw		- Example -	
F - Flat Fillister Head Screw			
- Allen-head Screw			
- Allen-head Set Screw			

- (2) To simplify the exploded view, the part numbers of normal screws, nut, washers, and retaining rings are not expressed but summarized in the table below.

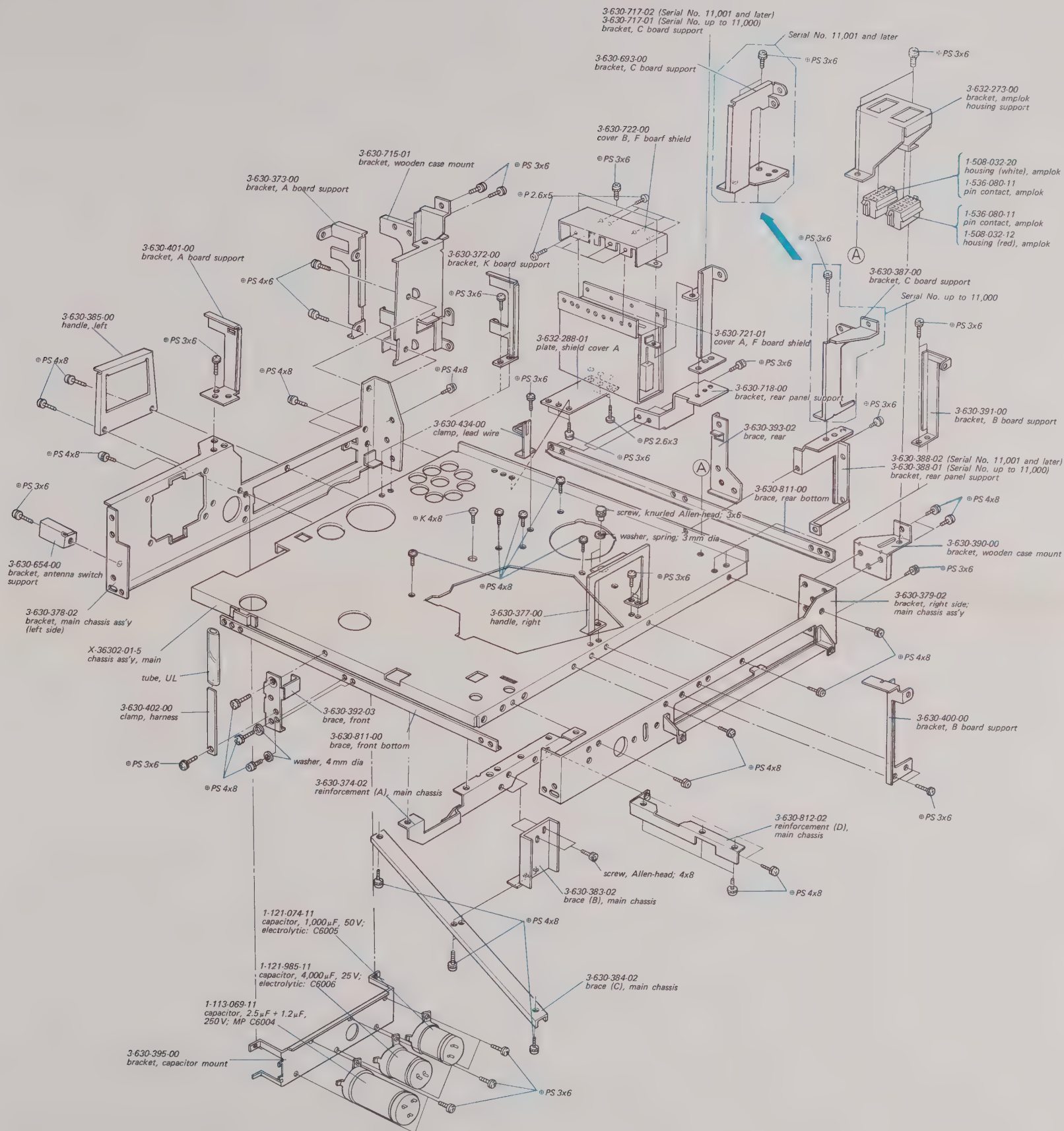
<u>Part No.</u>	<u>Description</u>	<u>Part No.</u>	<u>Description</u>
7-621-259-25	screw, @ P 2.6 x 4	7-624-109-01	retaining ring, 5 mm dia
7-621-259-35	screw, @ P 2.6 x 5	7-624-110-01	retaining ring, 6 mm dia
7-621-259-55	screw, @ P 2.6 x 8	7-624-112-01	retaining ring, 8 mm dia
7-621-259-85	screw, @ P 2.6 x 14	7-624-132-01	retaining clip, type "C"; 10 mm dia
7-621-260-05	screw, @ P 2.6 x 16	7-624-132-11	retaining clip, type "C"; 10 mm dia
7-621-559-15	screw, @ K 2.6 x 3	7-624-190-31	retaining clip, type "C-STW"; 4 mm dia
7-621-559-25	screw, @ K 2.6 x 4	7-626-202-31	cotter pin, 1 x 10 mm dia
7-621-559-35	screw, @ K 2.6 x 5	7-626-204-41	cotter pin, 1.6 x 12 mm dia
7-621-559-45	screw, @ K 2.6 x 6	7-629-100-19	nail, R 1 x 6
3-701-501-01	set screw, Allen-head 2 x 3	7-681-668-01	screw, @ F 4 x 30
3-701-504-01	set screw, Allen-head 2.6 x 10	7-682-146-01	screw, @ P 3 x 5
7-621-773-65	screw, @ B 2.6 x 4	7-682-148-13	screw, @ P 3 x 8
7-623-107-02	washer, 2.6 mm dia (small)	7-682-161-05	screw, @ P 4 x 8
7-623-107-12	washer, 2.6 mm dia (middle)	7-682-175-01	screw, @ P 5 x 10
7-623-108-02	washer, 3 mm dia (small)	7-682-247-01	screw, @ K 3 x 6
7-623-108-12	washer, 3 mm dia (middle)	7-682-248-01	screw, @ K 3 x 8
7-623-108-20	washer, 3 mm dia (middle)	7-682-370-07	screw, @ RK 4 x 40
7-623-108-22	washer, 3 mm dia (large)	7-682-545-05	screw, @ B 3 x 4
7-623-110-02	washer, 4 mm dia (small)	7-682-547-05	screw, @ B 3 x 6
7-623-110-12	washer, 4 mm dia (middle)	7-682-553-05	screw, @ B 3 x 20
7-623-112-12	washer, 5 mm dia (middle)	7-682-645-01	screw, @ PS 3 x 4
7-623-207-12	washer, spring 2.6 mm dia	7-682-646-01	screw, @ PS 3 x 5
7-623-208-12	washer, spring 3 mm dia	7-682-647-01	screw, @ PS 3 x 6
7-623-210-12	washer, spring 4 mm dia	7-682-647-05	screw, @ PS 3 x 6
7-623-408-01	lock washer, external tooth; 3 mm dia	7-682-648-01	screw, @ PS 3 x 8
7-623-412-01	lock washer, external tooth; 5 mm dia	7-682-649-01	screw, @ PS 3 x 10
7-623-508-01	lug, 3 mm dia	7-682-650-01	screw, @ PS 3 x 12
7-623-510-01	lug, 4 mm dia	7-682-661-01	screw, @ PS 4 x 8
7-623-618-00	eyelet, 2 x 5	7-682-662-01	screw, @ PS 4 x 10
7-623-633-00	eyelet, 3 x 5	7-682-947-01	screw, @ PSW 3 x 6
7-623-639-00	eyelet, 4 x 5	3-701-505-01	set screw, Allen-head 3 x 3
7-623-905-01	washer, fiber 2 mm dia	3-701-508-01	set screw, Allen-head 3 x 6
7-623-908-01	washer, fiber 3 mm dia	3-701-510-01	set screw, Allen-head 4 x 4
7-623-910-21	washer, fiber 4 mm dia (t = 0.25)	7-683-403-01	screw, Allen-head 3 x 6
7-623-910-31	washer, fiber 4 mm dia (t = 0.5)	3-701-552-11	screw, knurled Allen-head M 3 x 15
7-623-912-21	washer, fiber 5 mm dia (t = 0.25)	3-701-547-01	screw, knurled Allen-head M 3 x 6
7-623-912-31	washer, fiber 5 mm dia (t = 0.5)	7-684-013-01	nut, 3 mm dia
7-624-104-01	retaining ring, 2 mm dia	7-684-014-00	nut, 4 mm dia
7-624-105-01	retaining ring, 2.3 mm dia	7-684-024-00	nut, 4 mm dia
7-624-106-01	retaining ring, 3 mm dia	7-684-034-00	nut, 4 mm dia
7-624-108-01	retaining ring, 4 mm dia		

12-2. EXPLODED VIEW (A)



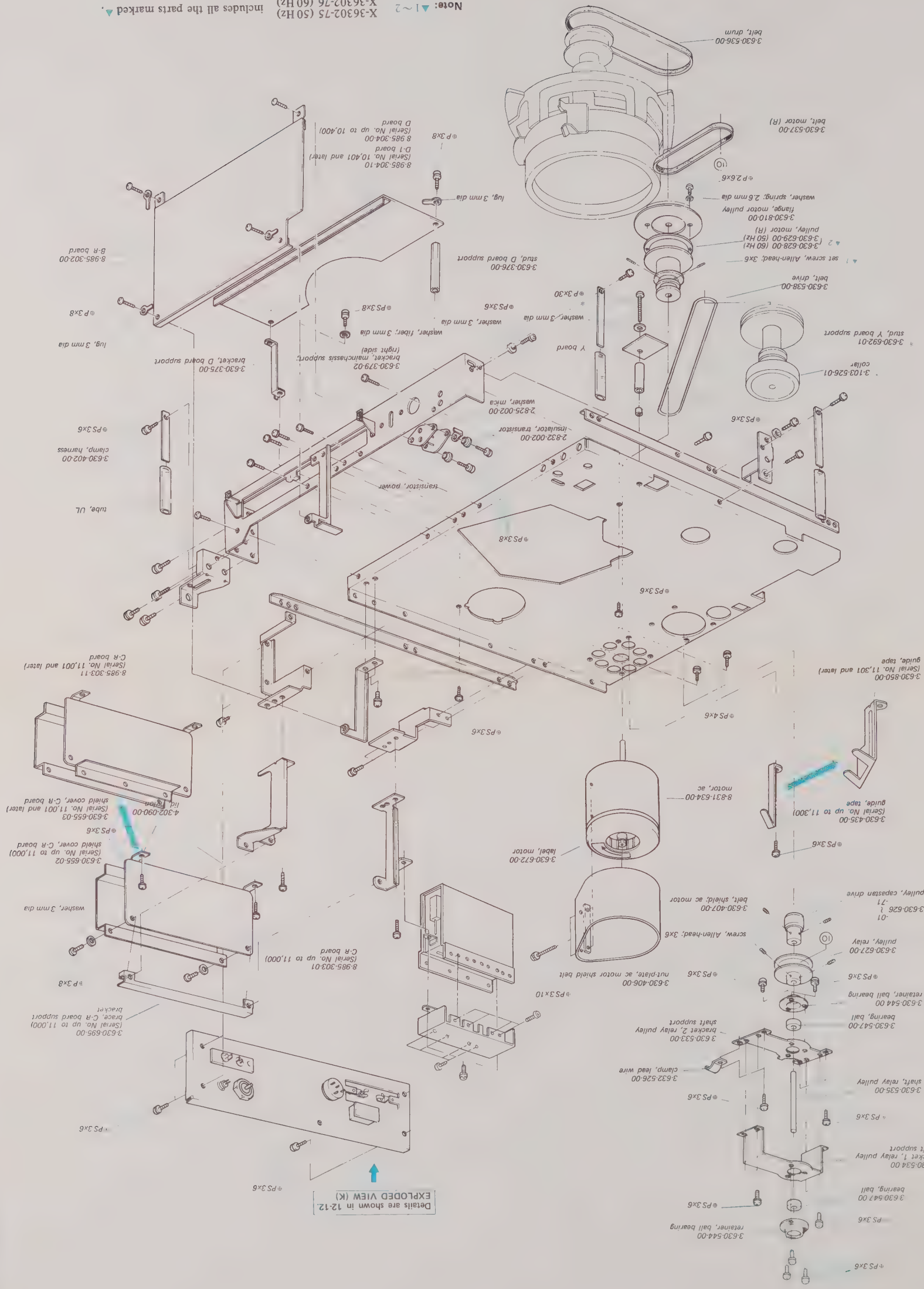
Note: ● 1 ~ 4 Panel ass'y, control includes all the parts marked ●.

▲ 1 ~ 3 Case ass'y, wooden includes all the parts marked ▲

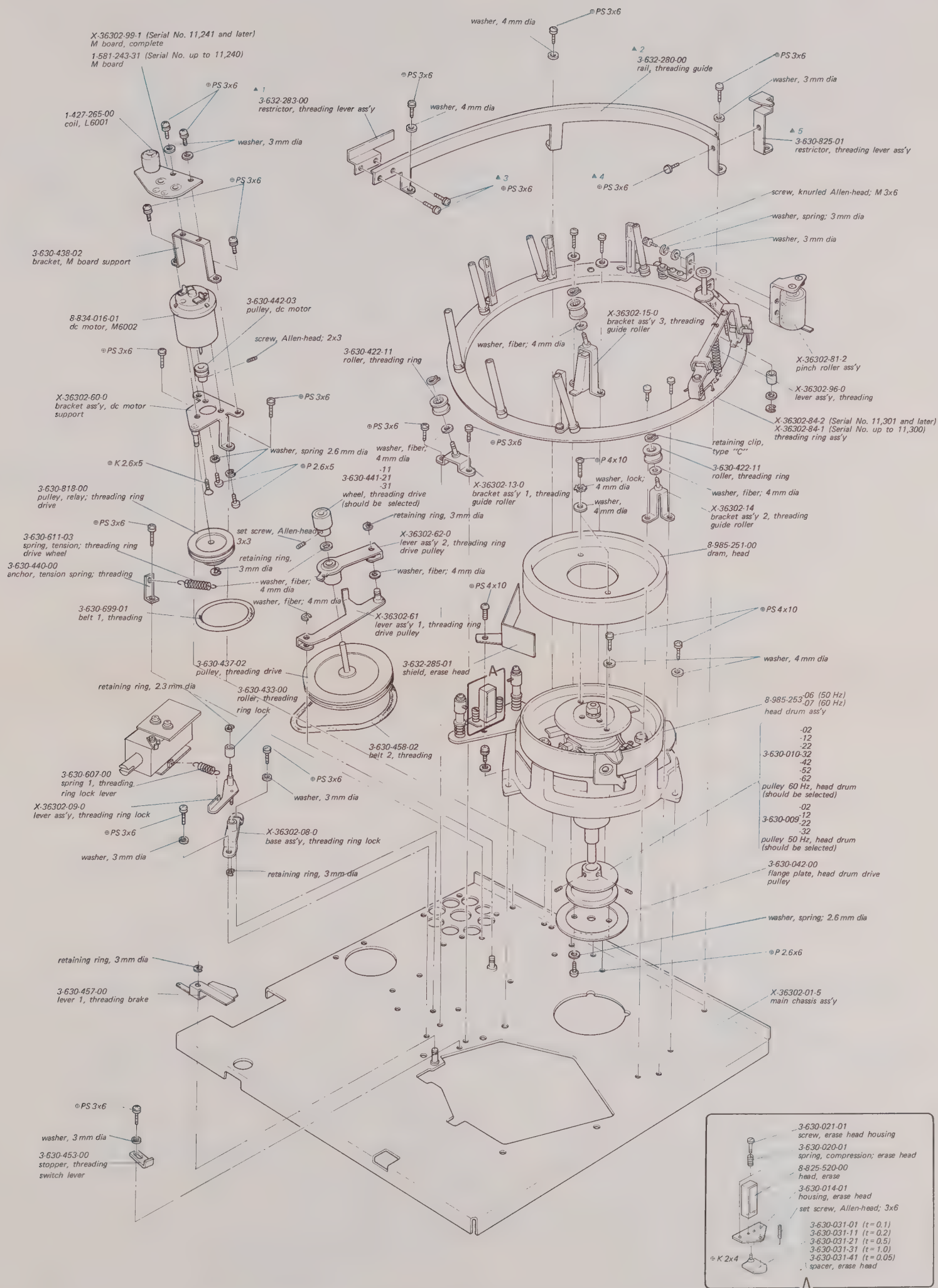




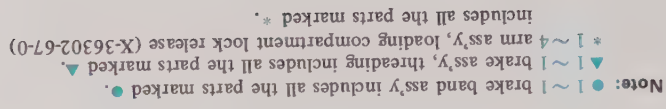


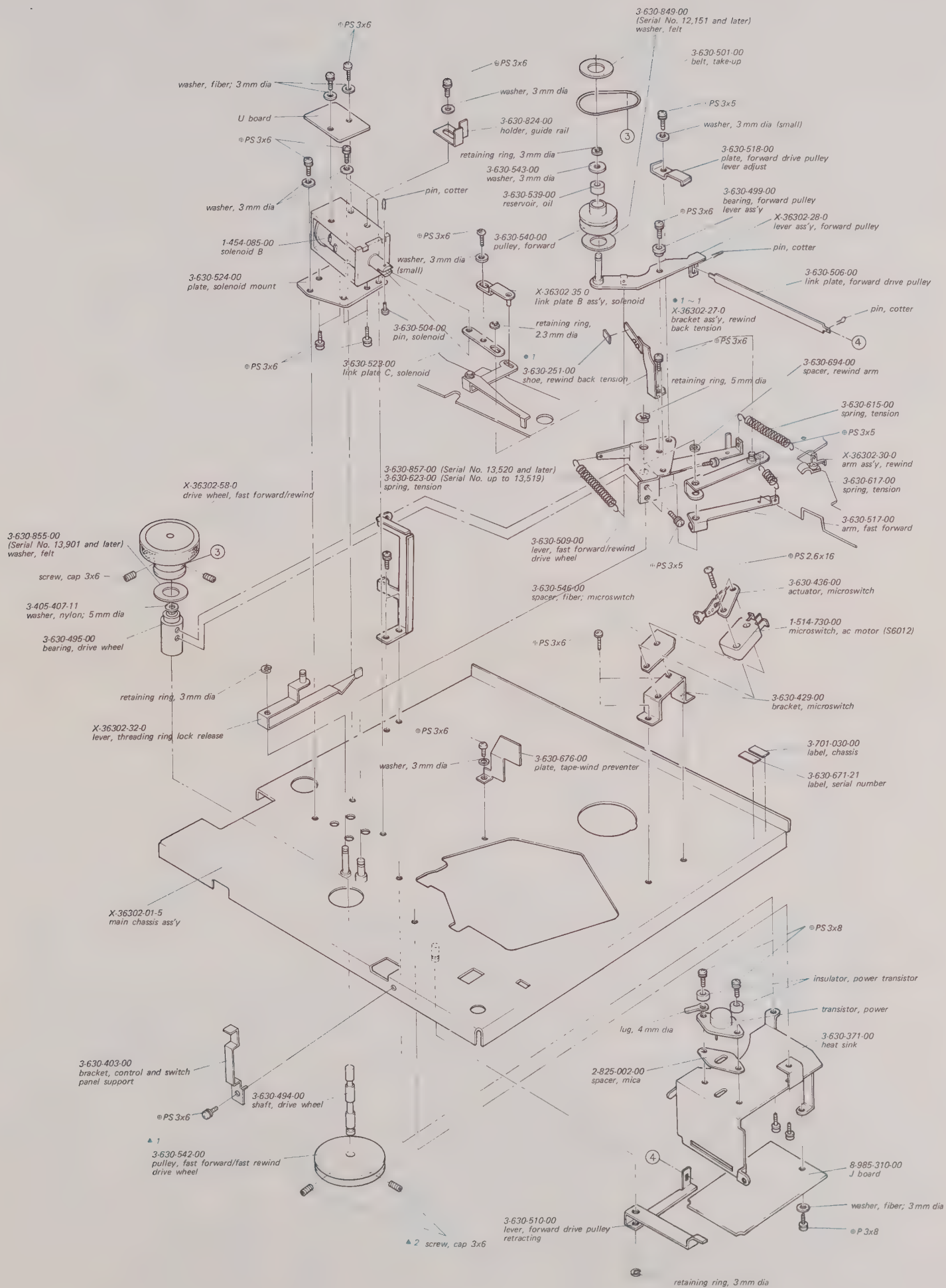


Note: $\blacktriangle 1 \sim 2$ X-36302-75 (50 Hz) X-36302-76 (60 Hz) includes all the parts marked $\blacktriangle$. All the parts marked * are for serial No. up to 10,400.



Note: ▲1~5 threading guide rail ass'y (X-36322-24-0) includes all the parts marked ▲.

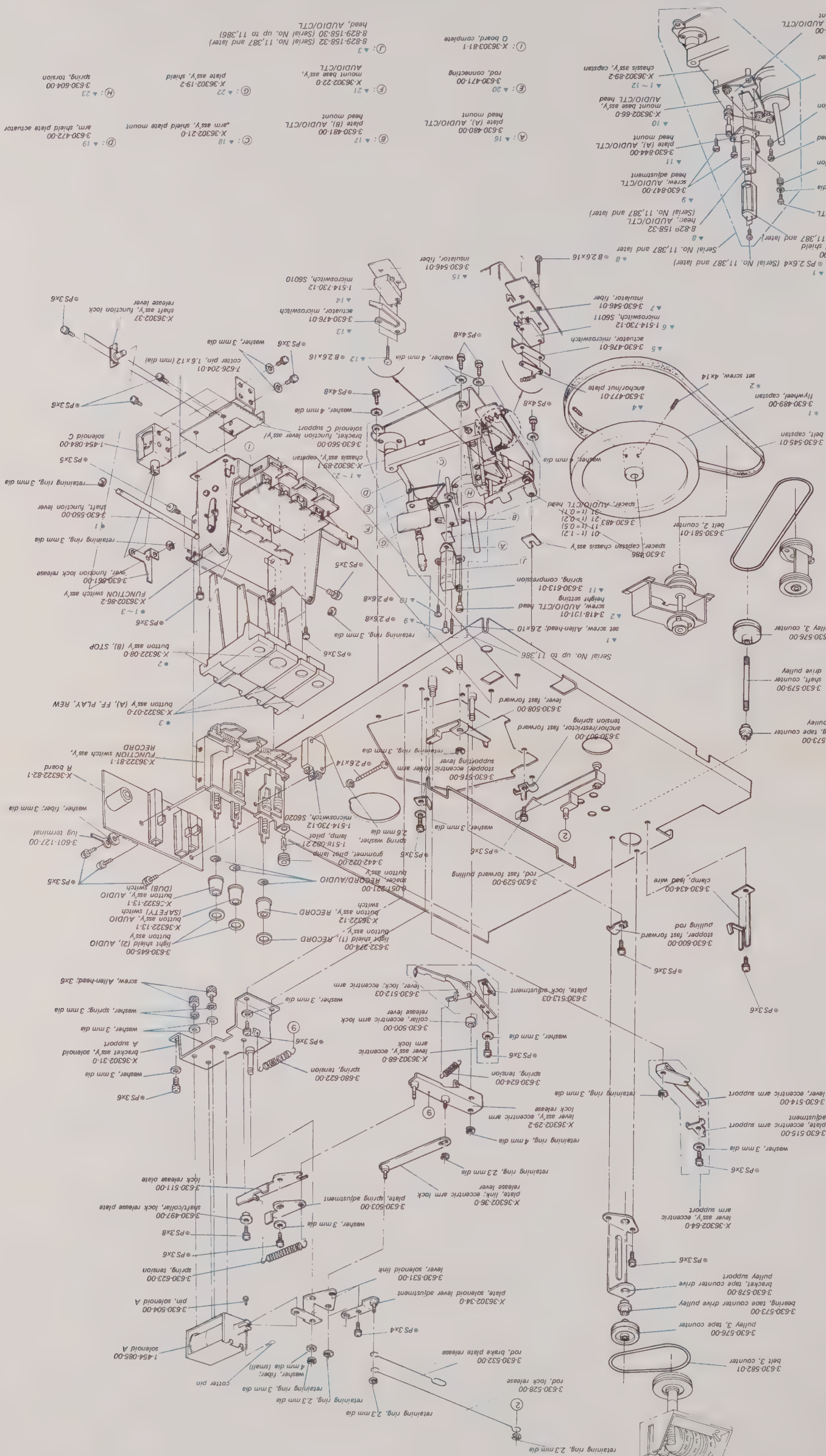




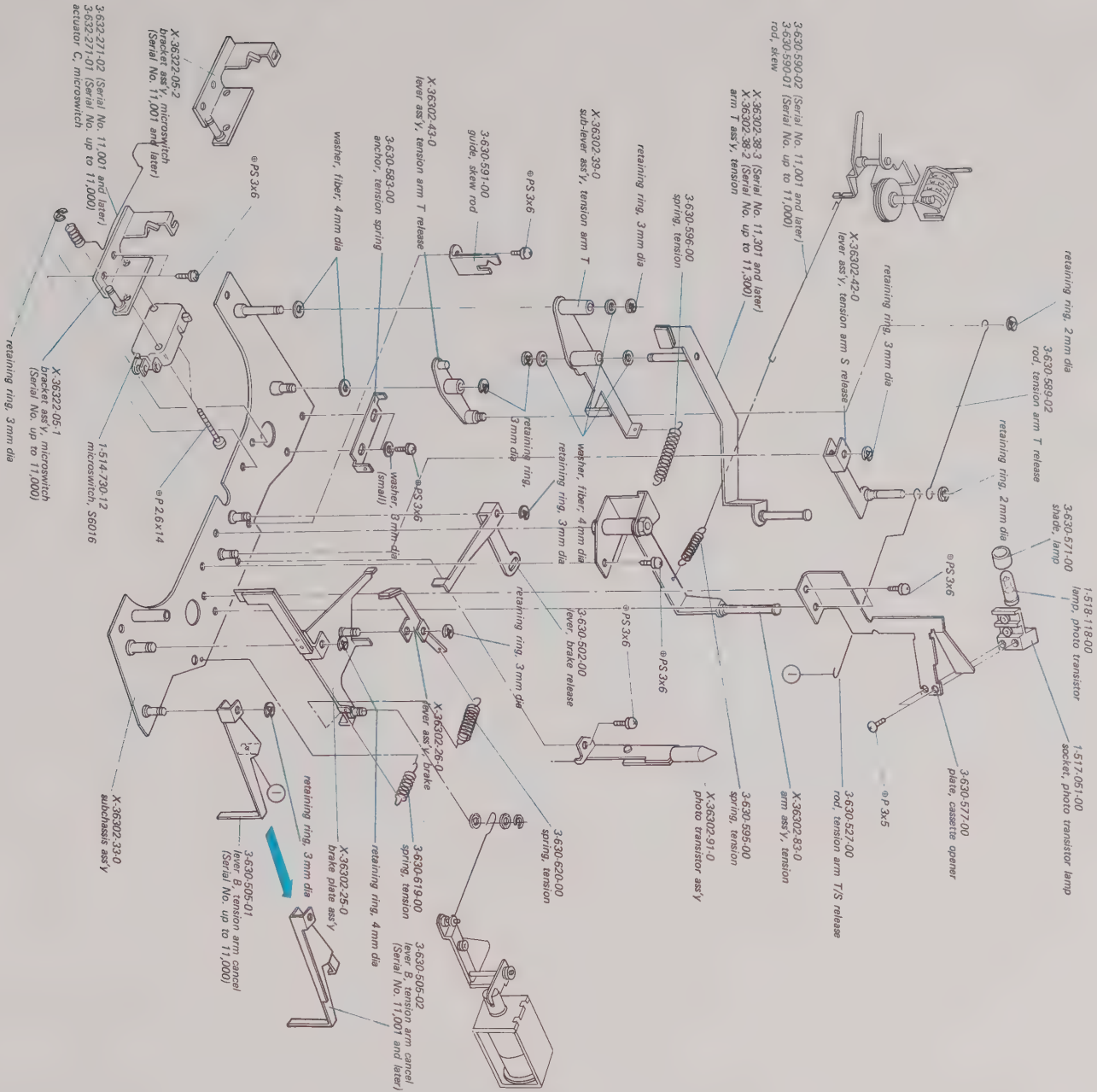
Note: ▲ 1 ~ 2 X-36302-77-0 (pulley ass'y, fast forward/rewind drive wheel) includes all the parts marked ▲.

● 1 ~ 1 bracket ass'y, rewind back tension includes all the parts marked ●.

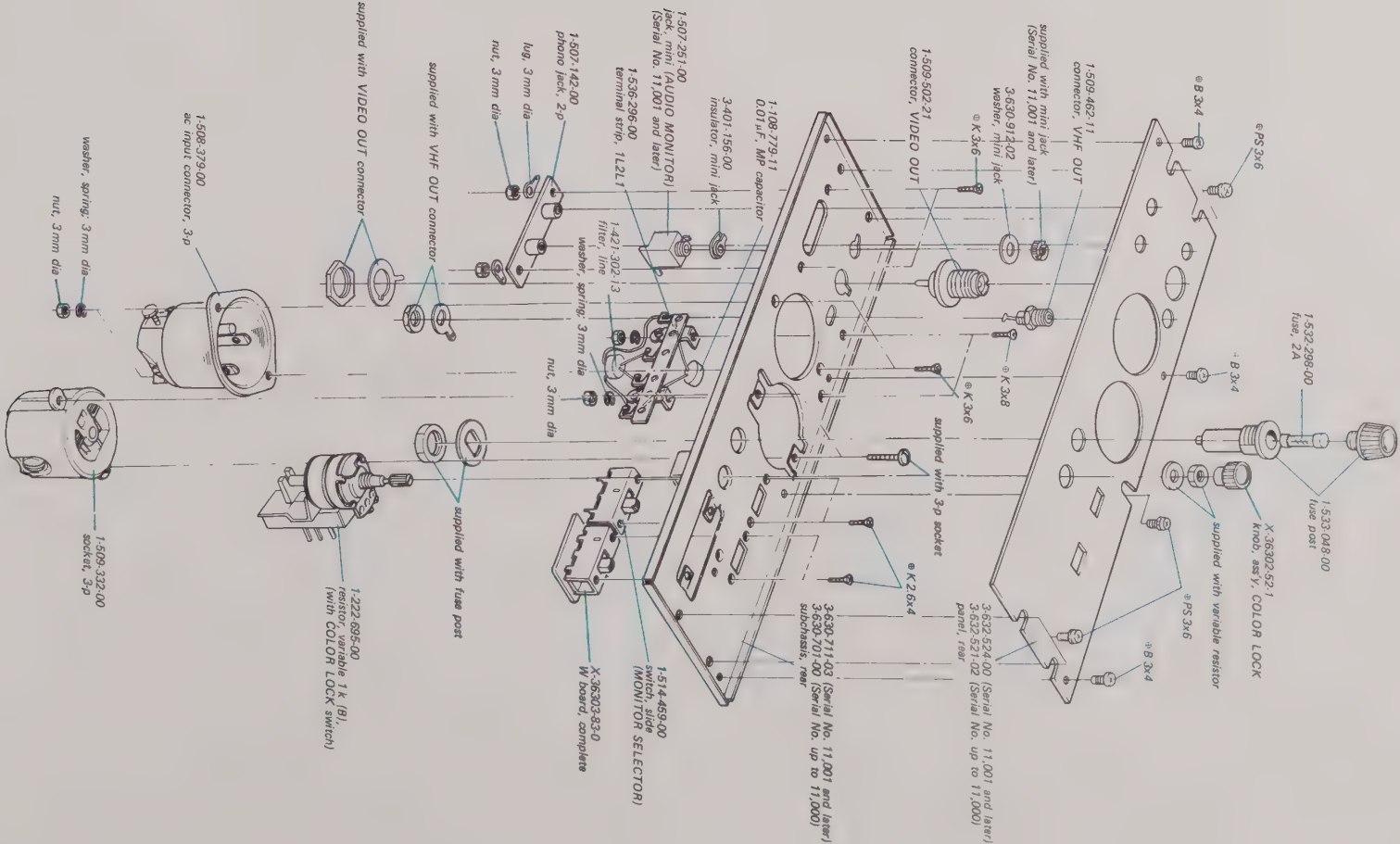
Note: ▲ 1 ~ 23 Capstan chassis ass'y (X-36302-89-1) includes all the parts marked ▲
● 1 ~ 3 Function switch ass'y (X-36302-86-2) includes all the parts marked ●
* 1 ~ 2 Flywheel ass'y (X-36302-74-0) includes all the parts marked *



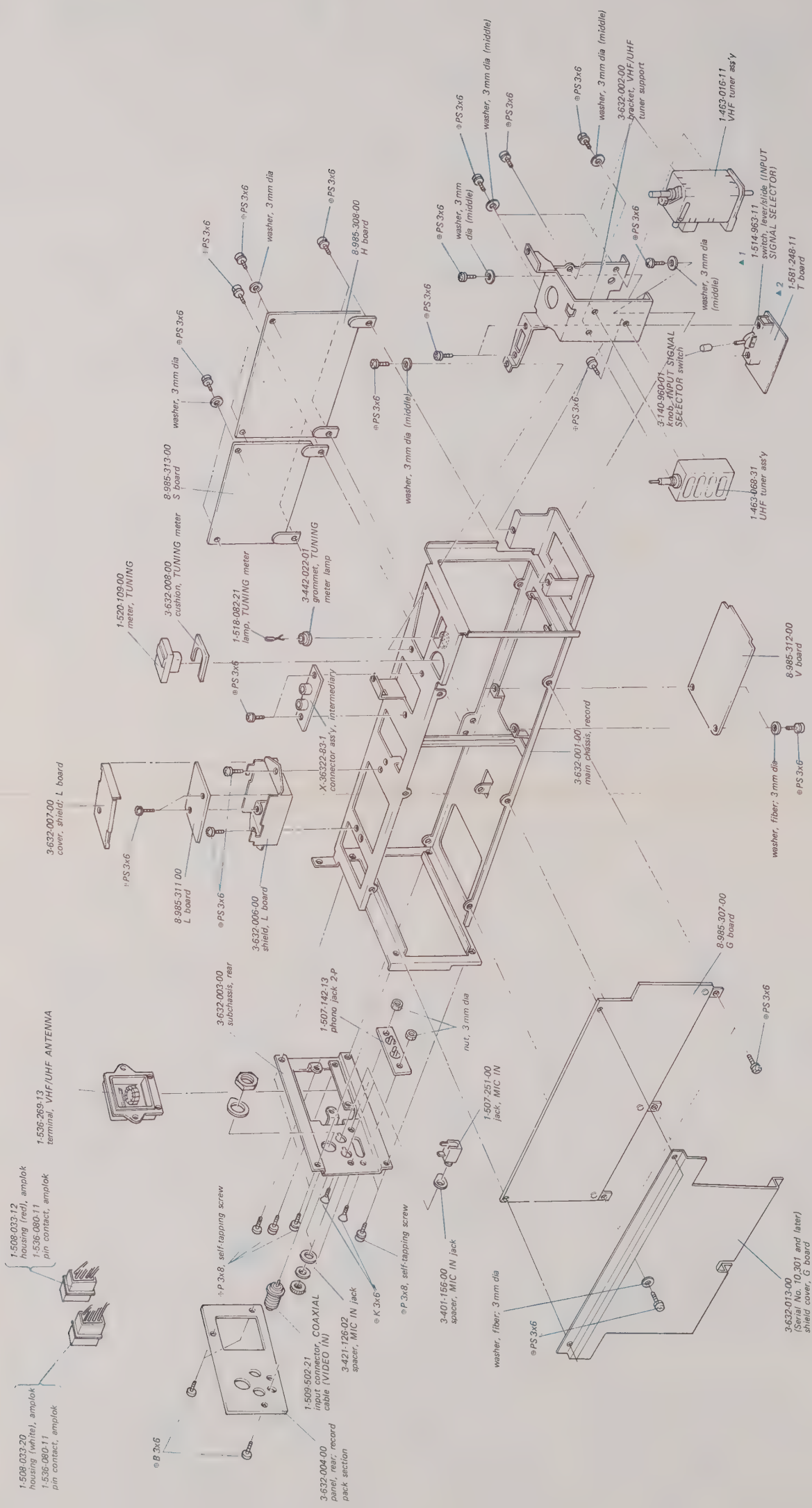
12-11. EXPLODED VIEW (J)



12-12. EXPLODED VIEW (K)



12-13. EXPLODED VIEW (L)



Note: ▲1~2 X-36303-84-1 (T board, complete) includes all the parts marked ▲.

SECTION 13

ELECTRICAL PARTS LIST

<u>Ref. No.</u>	<u>Part No.</u>	<u>Description</u>	<u>Ref. No.</u>	<u>Part No.</u>	<u>Description</u>
MOUNTED CIRCUIT BOARDS			D1402	diode	1S1555
8-985-301-01	A-R Board, complete		D1403	diode	1S1555
8-985-302-01	B-R Board, complete		D1501	diode	1S2144A
8-985-303-01	C-R Board, complete (Se. No. up to 11,000)		D1502	diode	1S2144A
8-985-303-11	C-R Board, complete (Se. No. 11,001 and later)		D1503	diode	1S2144A
8-985-304-00	D Board, complete (Se. No. up to 10,400)		D1504	diode	1S2144A
	Y Board, complete (Se. No. up to 10,400)		D1505	diode	RD13A
8-985-304-10	D-1 Board, complete (Se. No. 10,401 and later)		D1506	diode	1S2144A
8-985-305-00	E Board, complete (Se. No. up to 19,100)		D1507	diode	1S2144A
8-985-415-00	E-P Board, complete (Se. No. 19,101 and later)		D1508	diode	1S2144A
8-985-306-00	F Board, complete		D1509	diode	1S2144A
8-985-307-00	G Board, complete		D1510	diode	1S2144A
8-985-308-00	H Board, complete		D1511	diode	1S2144A
8-985-309-00	K Board, complete		D1512	diode	1S2144A
8-985-310-00	J Board, complete		D1513	diode	1S2144A
8-985-311-00	L Board, complete		D1514	8-719-815-87	diode 1S1587
8-985-312-00	V Board, complete		D1515	8-719-815-87	diode 1S1587
8-985-313-00	S Board, complete		D1516	8-719-815-87	diode 1S1587
X-36302-99-1	M Board, complete		D1517	8-719-815-87	diode 1S1587
	N Board, complete (Se. No. up to 11,000)		D1518		diode 1S1587
X-36302-98-1	Nh Board, complete (Se. No. 11,001 and later)		D1519		diode 1S1587
X-36302-82-0	VHF/AUDIO Switch Board		D1527		diode 1S2144A
	(Se. No. up to 11,000)		D1528		diode 1S2144A
X-36302-97-1	Ph Board, complete (Se. No. 11,001 and later)		D1529		diode 1S1555
X-36303-81-1	Q Board, complete		D1530		diode 1S1555
X-36303-82-1	R Board, complete		D1531		diode 1S2144A
X-36303-83-1	W Board, complete		D1532		diode 1S2144A
X-36303-84-1	T Board, complete		D1533		diode 1S2144A
1-581-309-11	U Board, complete		D1534		diode 1S2144A
1-463-016-11	VHF Tuner Ass'y (BT-702WU)		D1535		diode 1S2144A
1-463-068-31	UHF Tuner Ass'y (BT-106)		D1536		diode 1S1925
			D1537		diode 1S1555
			D1538		diode RD6A
			D1539		diode RD6A
SEMICONDUCTORS			D2001	8-719-815-55	diode 1S1555
D1001	8-719-314-41	diode 1S2144A	(D2101)		
D1002	8-719-314-41	diode 1S2144A	D2002	8-719-210-02	diode 10D-2
D1003	8-719-314-41	diode 1S2144A	(D2102)		
D1004	8-719-314-41	diode 1S2144A	D2201	8-719-815-55	diode 1S1555
D1005		diode RD4A	D2202	8-719-815-55	diode 1S1555
D1006	8-719-815-87	diode 1S1587	D2203	8-719-815-55	diode 1S1555
D1007	8-719-815-87	diode 1S1587			
D1008	8-719-815-87	diode 1S1587	D3001		diode 1T22
D1009	8-719-815-87	diode 1S1587	D3002		diode 1S1555
D1010		diode 1S2144A	D3003		diode 1S1555
D1011		diode 1S2144A	D3004		diode 1S1555
D1012		diode 1S2144A	D3005		diode 1S1555
D1013		diode 1S2144A	D3006		diode 1S1555
D1401	8-719-815-55	diode 1S1555	D3007		diode 1S1555

Note: Se. No. means Serial Number

<u>Ref. No.</u>	<u>Part No.</u>	<u>Description</u>		<u>Ref. No.</u>	<u>Part No.</u>	<u>Description</u>	
D3008		diode	1S1555	D6107		diode	SA-2
D3009		diode	1S1555	D6108		diode	SA-2
D3010		diode	1S1555	D6109		diode	1S331
D3011		diode	1S1555	D7001	8-719-815-87	diode	1S1587
D3012		diode	1T22	D7002	8-719-815-87	diode	1S1587
D3013		diode	1S1555	D7003	8-719-815-87	diode	1S1587
D3014		diode	1S1555	D8201		diode	1T261
D3015		diode	1S1555	D8202		diode	1T40
D3016		diode	1S1555	D8203		diode	ZB1-11
D3017	8-719-815-55	diode	1S1555	D8204		diode	1T261
D4001		diode	1S1555	D8205		diode	1T40
D4002		diode	1S1555	IC1501		IC	CX-034
D4003		diode	1S1555	IC3001		IC	CX-506
D4004		diode	1S1555	IC3002		IC	CX-506
D4005		diode	1S1555	IC8201		IC	M-5142P
D4006		-----		TH1001	8-690-006-00	thermistor	S-1250
D4007		diode	10D-2	TH8201		thermistor	
D4008		diode	1S1555	Q1001		transistor	2SC403B
D4009		diode	1S1555	Q1002		transistor	2SC403B
D4010		diode	1S1555	Q1003		transistor	2SB403B
D4011		diode	1S1555	Q1004		transistor	2SB403B
D4012		diode	1S1555	Q1005		transistor	2SB403B
D4013		diode	10D-2	Q1006		transistor	2SA678
D4014		diode	1S1555	Q1007		transistor	2SC403B
D4015		diode	10D-2	Q1008		transistor	2SC403B
C4016		diode	1S1555	Q1009		transistor	2SK 23A
D4017		diode	RD7A	Q1010		transistor	2SC403B
D4018		diode	1S1555	Q1011		transistor	2SC403B
D4019		diode	1S1555	Q1012		transistor	2SC403B
D4020		diode	1S1555	Q1013		transistor	2SC403B
D4021		diode	1S1555	Q1014		transistor	2SC403B
D4022		diode	1S1555	Q1015		transistor	2SC403B
D4023		diode	1S1555	Q1016		transistor	2SC403B
D4024		diode	1S1555	Q1017		transistor	2SC403B
D4025		diode	1S1555	Q1018		transistor	2SC403B
D4026	8-719-815-55	diode	1S1555	Q1019		transistor	2SC403B
D4027	8-719-815-55	diode	1S1555	Q1020		transistor	2SC403B
D4028	8-719-815-55	diode	1S1555	Q1021		transistor	2SC403B
D4029	8-719-815-55	diode	1S1555	Q1022		transistor	2SC403B
D4030	8-719-815-55	diode	1S1555	Q1023		transistor	2SC403B
D4031	8-719-815-55	diode	1S1555	Q1024		transistor	2SC403B
D6001		diode	10D-2	Q1025		transistor	2SC403B
D6002		diode	10D-2	Q1026		transistor	2SC403B
D6003		diode	10D-2	Q1027		transistor	2SC403B
D6004	8-719-210-02	diode	10D-2	Q1028		transistor	2SC403B
D6101		diode	CD-2	Q1029		transistor	2SC403B
D6102		diode	CDR-2	Q1030		transistor	2SA678
D6103		diode	RD-13A	Q1031		transistor	2SK 23A
D6104		diode	1S331				
D6105		diode	SA-2				
D6106		diode	SA-2				

(Se. No. 10,401
and later)

<u>Ref. No.</u>	<u>Part No.</u>	<u>Description</u>	<u>Ref. No.</u>	<u>Part No.</u>	<u>Description</u>
Q1032		transistor 2SC403B	Q1509		transistor 2SC403B
Q1033		transistor 2SA678	Q1510		transistor 2SC403B
Q1034		transistor 2SA678	Q1511	8-724-354-00	transistor 2SC403B
Q1035		transistor 2SC403B	Q1512	8-724-354-00	transistor 2SC403B
Q1036		transistor 2SC403B	Q1513		transistor 2SC403B
Q1037		transistor 2SC403B	Q1514		transistor 2SK23A
Q1038		transistor 2SC403B	Q1515		transistor 2SC403B
Q1039		transistor 2SC403B	Q1516		transistor 2SC403B
Q1040		transistor 2SC403B	Q1517		transistor 2SC403B
Q1041		transistor 2SC403B	Q1518		transistor 2SC403B
Q1042		transistor 2SC403B	Q1519		transistor 2SC403B
Q1043		transistor 2SC403B	Q1520		transistor 2SC403B
Q1044		transistor 2SC403B	Q1521		transistor 2SC403B
Q1045	8-724-355-00	transistor 2SC403B	Q1522		transistor 2SC403B
Q1046	8-727-786-00	transistor 2SA678	Q1523		transistor 2SA678
Q1047	8-725-412-00	transistor 2SC1124	Q1524		-----
Q1048		transistor 2SC403B	Q1525		transistor 2SC403B
Q1049		transistor 2SC403B	Q1526		transistor 2SC403B
Q1050		transistor 2SC403B	Q1527		transistor 2SC403B
Q1051	8-724-355-00	transistor 2SC403B	Q1528		transistor 2SA678
Q1052	8-727-786-00	transistor 2SA678	Q1529		transistor 2SC634A
Q1053	8-725-412-00	transistor 2SC1124	Q1530		transistor 2SC634A
Q1054	8-727-561-36	transistor 2SC756	Q1531		transistor 2SC634A
Q1055		transistor 2SC403B	Q1532	8-724-354-00	transistor 2SC403B
Q1401		transistor 2SK43	Q1533	8-724-354-00	transistor 2SC403B
Q1402		transistor 2SC403B-5	Q1534		transistor 2SC403B
Q1403		transistor 2SC403B-5	Q1535		transistor 2SC403B
Q1404		transistor 2SC403B-5	Q1536		transistor 2SC403B
Q1405		transistor 2SC634A-6	Q1537		transistor 2SC403B
Q1406		transistor 2SC403B-5	Q1538		transistor 2SC403B
Q1407		transistor 2SK43	Q1539		transistor 2SC403B
Q1408		transistor 2SC403B-5	Q1540		transistor 2SC403B
Q1409		transistor 2SC403B-5	Q1541		transistor 2SC403B
Q1410		transistor 2SC403B-5	Q1542		transistor 2SC403B
Q1411		transistor 2SC634A-6	Q1543		transistor 2SC403B
Q1412		transistor 2SC403B-5	Q1544		transistor 2SC403B
Q1413		transistor 2SC403B-5	Q1545		transistor 2SC1124
Q1414		transistor 2SC403B-5	Q1546		transistor 2SK43
Q1415		transistor 2SC403B-5	Q1547		transistor 2SC403B
Q1416		transistor 2SC403B-5	Q1548		transistor 2SC403B
Q1417		transistor 2SC403B-5	Q1549		transistor 2SC403B
Q1418		transistor 2SC634A-6	Q1550		transistor 2SC403B
Q1419		transistor 2SC634A-6			
Q1501		transistor 2SC403B	Q2001		
Q1502		transistor 2SC403B	(Q2101)		transistor 2SC631A
Q1503		transistor 2SC403B	Q2002		
Q1504		transistor 2SC403B	(Q2102)		transistor 2SC631A
Q1505		transistor 2SC403B	Q2003		
Q1506		transistor 2SC634A	(Q2103)		transistor 2SC631A
Q1507		transistor 2SC634A	Q2004		
Q1508		transistor 2SC634A	(Q2104)		transistor 2SC634A
			Q2005		
			(Q2105)		transistor 2SC634A

<u>Ref. No.</u>	<u>Part No.</u>	<u>Description</u>	<u>Ref. No.</u>	<u>Part No.</u>	<u>Description</u>
Q2006 (Q2106)		transistor 2SC634A	Q3014		transistor 2SC634A
Q2007 (Q2107)		transistor 2SC634A	Q3015	8-726-387-00	transistor 2SC634A
Q2008		transistor 2SC634A (Se. No. 11,001 and later)	Q3016		transistor 2SC634A
			Q3017		transistor 2SC634A
			Q3018		transistor 2SC634A
			Q3019		transistor 2SC634A
			Q3020		transistor 2SC634A
			Q3021		transistor 2SC634A
Q2201 (Q2301)	8-726-357-10	transistor 2SC631A	Q3022	8-726-387-00	transistor 2SC634A
Q2202 (Q2302)	8-726-387-30	transistor 2SC634A	Q3023	8-726-387-00	transistor 2SC634A
Q2203 (Q2303)	8-726-357-10	transistor 2SC631A	Q4001		transistor 2SC634A
Q2204 (Q2304)	8-726-357-10	transistor 2SC631A	Q4002		transistor 2SC634A
Q2205 (Q2305)	8-726-387-00	transistor 2SC634A	Q4003		transistor 2SC634A
Q2206 (Q2306)	8-726-387-00	transistor 2SC634A	Q4004		transistor 2SC634A
Q2207 (Q2307)	8-726-387-00	transistor 2SC634A	Q4005		transistor 2SC634A
Q2208 (Q2308)	8-726-387-00	transistor 2SC634A	Q4006		transistor 2SC634A
Q2209	8-726-387-00	transistor 2SC634A	Q4007		transistor 2SC634A
Q2210	8-726-387-00	transistor 2SC634A	Q4008		transistor 2SD291
Q2211	8-726-387-00	transistor 2SC634A	Q4009		transistor 2SC634A
		transistor 2SD291 (Se. No. up to 19,100)	Q4010		transistor 2SC634A
Q2401	8-720-215-60	transistor 2SC1124 (Se. No. 19,101 and later)	Q4011		transistor 2SD291
Q2402	8-726-387-00	transistor 2SC634A (Se. No. up to 19,100)	Q4012		transistor 2SC634A
		transistor 2SC1124 (Se. No. 19,101 and later)	Q4013		transistor 2SC634A
Q2403		transistor 2SC634A (Se. No. 19,101 and later)	Q4014		transistor 2SC634A
			Q4015		transistor 2SC634A
			Q4016		transistor 2SC634A
Q3001		transistor 2SC634A	Q4017		transistor 2SC634A
Q3002		transistor 2SC634A	Q4018		transistor 2SC634A
Q3003		transistor 2SC634A	Q4019		transistor 2SC634A
Q3004		transistor 2SC634A	Q4020		transistor 2SC634A
Q3005		transistor 2SC634A	Q4021		transistor 2SC634A
Q3006		transistor 2SC634A	Q4022		transistor 2SC634A
Q3007		transistor 2SC634A	Q4023		transistor 2SC634A
Q3008		transistor 2SC634A	Q4024		transistor 2SD291
Q3009		transistor 2SC634A	Q4025		transistor 2SC634A
Q3010		transistor 2SC634A	Q4026		transistor 2SC634A
Q3011		transistor 2SC634A	Q4027		transistor 2SC634A
Q3012		transistor 2SD291	Q4028		transistor 2SC634A
Q3013		transistor 2SC634A	Q4029		transistor 2SC634A
			Q4030		transistor 2SC634A
			Q4031		transistor 2SC634A
			Q4032		transistor 2SC634A
			Q4033		transistor 2SC634A (Se. No. 10,401 and later)
			Q4034		transistor 2SC634A (Se. No. 10,401 and later)
			Q6001		transistor } 2SD316 or
			Q6002		transistor } 2SD82
			Q6003	8-720-040-71	transistor photo TX-407

<u>Ref. No.</u>	<u>Part No.</u>	<u>Description</u>	
Q6101		transistor	2SC1124
Q6102		transistor	2SC633A
Q6103		transistor	2SC1124
Q6104		transistor	2SC633A
Q6105		transistor	2SC1124
Q6106		transistor	2SC633A
Q7001	8-725-800-00	transistor	2SC1128
Q7002	8-725-800-00	transistor	2SC1128
Q8201		transistor	2SC918
Q8202		transistor	2SC918
Q8203		transistor	2SC1128
Q8204		transistor	2SC633A
Q8205		transistor	2SA611 or 2SA564A
Q8206		transistor	2SA610 or 2SA564A
Q8207		transistor	2SC633A
Q8208		transistor	2SC633A
Q8209		transistor	2SC633A
Q8210		transistor	2SC633A
Th2401		thermistor	S-1K (Se. No. 17,101 and later)

TRANSFORMERS, COILS AND INDUCTORS

DL1001	1-415-051-12	delay coil (A)	
DL1501	1-415-048-11	delay line	
DL1502	1-415-049-11	delay line (B)	
L1001	1-407-569-00	coil, variable	15 μ H
L1002	1-407-202-00	inductor, micro	4.7 mH
L1003	1-407-161-00	inductor, micro	22 μ H
L1004	1-407-569-00	coil, variable	10 μ H
L1005	1-407-574-00	coil, variable	68 μ H
L1006	1-407-160-00	inductor, micro	18 μ H
L1007	1-407-166-00	inductor, micro	56 μ H
L1008	1-411-095-00	coil, variable	56 μ H
L1009	1-407-160-00	inductor, micro	18 μ H
L1010	1-407-570-00	coil, variable	15 μ H
L1011	1-407-172-00	inductor, micro	180 μ H
L1012	1-407-172-00	inductor, micro	180 μ H
L1013	1-407-161-00	inductor, micro	22 μ H
L1014	1-407-579-00	coil, variable	1 mH
L1015	1-407-171-00	inductor, micro	150 μ H
L1401	1-411-095-11	coil, variable	56 μ H
L1402	1-411-095-11	coil, variable	56 μ H
L1403	1-407-269-00	inductor, variable	2.2 mH
L1404	1-407-166-00	inductor, micro	56 μ H

L1405	1-407-176-00	inductor, micro	390 μ H
L1406	1-407-269-00	inductor, variable	2.2 mH
L1501	1-407-189-00	inductor, micro	8.2 μ H
L1502	1-407-189-00	inductor, micro	8.2 μ H
L1503	1-407-173-00	inductor, micro	220 μ H
L1504	1-407-173-00	inductor, micro	220 μ H
L1505	1-407-174-00	inductor, micro	270 μ H
L1506	1-407-205-21	inductor, micro	8.2 mH
L1507		-----	
L1508		-----	
L1509	1-407-202-21	inductor, micro	4.7 mH
L1510	1-407-157-00	inductor, micro	10 μ H
L1511	1-407-575-00	coil, variable	100 μ H
L1512	1-407-583-00	coil, variable	270 μ H
L1513	1-407-569-00	coil, variable	10 μ H
L1514	1-407-569-00	coil, variable	10 μ H
L1515	1-407-569-00	coil, variable	10 μ H
L2001 (L2101)	1-407-259-00	inductor, variable	220 μ H
L2002 (L2102)	1-407-240-00	inductor, variable	22 mH
L2201 (L2301)	1-407-090-12	coil, variable	1.5 mH
L2401	1-407-240-00	inductor, variable	22 mH
L2402	1-407-240-00	inductor, variable	22 mH
L6001	1-427-265-13	coil	
L6002	1-421-303-13	coil, line filter	
L6003	1-407-090-00	coil, dummy	1.5 mH
L7001	1-407-178-00	inductor, micro	1 μ H
L7002	1-407-178-00	inductor, micro	1 μ H
L7003	1-407-158-00	inductor, micro	12 μ H
L8201	1-407-184-00	inductor, micro	3.3 μ H
L8202	1-407-184-00	inductor, micro	3.3 μ H
L8203	1-407-184-00	inductor, micro	3.3 μ H
L8204	1-407-182-00	inductor, micro	2.2 μ H
L8205	1-407-184-00	inductor, micro	3.3 μ H
L8206	1-407-504-00	coil, detector	
L8207	1-407-160-00	inductor, micro	18 μ H
L8208	1-407-158-00	inductor, micro	12 μ H
L8209	1-407-158-00	inductor, micro	12 μ H
L8210	1-407-189-00	inductor, micro	8.2 μ H
L8211	1-407-171-00	inductor, micro	150 μ H
T1001	1-425-384-00	transformer, modulator	
T1002	1-425-715-00	transformer, RF	

<i>Ref. No.</i>	<i>Part No.</i>	<i>Description</i>	<i>Ref. No.</i>	<i>Part No.</i>	<i>Description</i>
T1003	1-425-714-00	transformer, output	C1009	1-105-673-12	0.01 $\pm 10\%$ 50V mylar
T1004	1-425-714-00	transformer, output	C1010	1-105-673-12	0.01 $\pm 10\%$ 50V mylar
T1401	1-425-704-12	transformer, RF	C1011	1-121-395-00	4.7 $\pm 100\%$ 25V electrolytic
T1402	1-425-704-12	transformer, RF	C1012	1-121-395-00	4.7 $\pm 100\%$ 25V electrolytic
T1501	1-459-047-00	transformer, balance modulator	C1013	1-121-410-00	47 $\pm 100\%$ 25V electrolytic
T1502	1-459-047-00	transformer, balance modulator	C1014	1-107-075-00	39p $\pm 5\%$ 50V silvered mica
T1503	1-407-584-00	transformer, burst gate	C1015	1-121-395-00	4.7 $\pm 100\%$ 25V electrolytic
T1504	1-425-544-00	transformer, differentiation	C1016	1-121-398-00	10 $\pm 100\%$ 25V electrolytic
T2401	1-433-153-11	transformer, osc (Se. No. up to 19,100)	C1017	1-121-416-00	100 $\pm 100\%$ 25V electrolytic
	1-433-162-00	transformer, osc (Se. No. 19,100 and later)	C1018	1-121-403-00	33 $\pm 100\%$ 16V electrolytic
T2501	1-423-166-00	transformer, input (Se. No. up to 12,500)	C1019	1-121-415-00	100 $\pm 100\%$ 16V electrolytic
	1-423-173-00	transformer, input (Se. No. 12,501 and later)	C1020	1-121-395-00	4.7 $\pm 100\%$ 25V electrolytic
T6001	1-441-797-12	transformer, power	C1021	1-127-083-00	0.47 $\pm 40\%$ 25V solid, aluminum
T6002	1-427-299-00	transformer, output	C1022	1-121-409-00	47 $\pm 100\%$ 16V electrolytic
T6003		(Se. No. 11,001 and later)	C1023	1-121-409-00	47 $\pm 100\%$ 16V electrolytic
T7001	1-425-666-00	transformer, tuning	C1024	1-121-410-00	47 $\pm 100\%$ 25V electrolytic
T8201	1-403-504-00	VIFT-1	C1025	1-121-391-00	1 $\pm 150\%$ 50V electrolytic
T8202	1-403-548-00	47.25 MHz, wave trap, VIFT-T1	C1026	1-107-085-00	100p $\pm 5\%$ 50V silvered mica
T8203	1-409-177-00	41.25 MHz, wave trap, VIFT-T2	C1027	1-101-006-00	0.047 $\pm 100\%$ 50V ceramic
T8204	1-403-549-00	39.75 MHz, wave trap, VIFT-T3	C1028	1-121-391-00	1 $\pm 150\%$ 50V electrolytic
T8205	1-403-550-00	VIFT-2	C1029	1-121-421-00	220 $\pm 100\%$ 16V electrolytic
T8206	1-403-550-00	VIFT-3	C1030	1-107-093-00	220p $\pm 5\%$ 50V silvered mica
T8207	1-409-174-00	41.25 MHz, wave trap, VIFT-T4	C1031	1-107-073-00	33p $\pm 5\%$ 50V silvered mica
T8208	1-403-524-00	VIFT-4	C1032	1-121-421-00	220 $\pm 100\%$ 16V electrolytic
T8209	1-403-350-00	SIFT-1	C1033	1-121-413-00	100 $\pm 100\%$ 6.3V electrolytic
T8210	1-403-371-00	SIFT-2	C1034	1-121-409-00	47 $\pm 100\%$ 16V electrolytic
T8211	1-403-372-00	SIFT-3	C1035	1-121-398-00	10 $\pm 100\%$ 25V electrolytic
T8212	1-409-146-00	4.5 MHz, wave trap	C1036	1-121-398-00	10 $\pm 100\%$ 25V electrolytic
CAPACITORS			C1037	1-121-409-00	47 $\pm 100\%$ 16V electrolytic
All capacitance values are in μF except as indicated with p, which means μF .			C1038	1-107-097-00	330p $\pm 5\%$ 50V silvered mica
C1001	1-121-413-00	100 $\pm 100\%$ 6.3V electrolytic	C1039	1-121-415-00	100 $\pm 100\%$ 16V electrolytic
C1002	1-121-415-00	100 $\pm 100\%$ 16V electrolytic	C1040	1-121-398-00	10 $\pm 100\%$ 25V electrolytic
C1003	1-107-088-00	130p $\pm 5\%$ 50V silvered mica	C1041	1-121-398-00	10 $\pm 100\%$ 25V electrolytic
C1004	1-121-421-00	220 $\pm 100\%$ 16V electrolytic	C1042	1-121-415-00	100 $\pm 100\%$ 16V electrolytic
C1005	1-107-089-00	150p $\pm 5\%$ 50V silvered mica	C1043	1-101-006-00	0.047 $\pm 100\%$ 50V ceramic
C1006	1-121-409-00	47 $\pm 100\%$ 16V electrolytic	C1044	1-101-006-00	0.047 $\pm 100\%$ 50V ceramic
C1007	1-121-391-00	1 $\pm 150\%$ 50V electrolytic	C1045	1-121-403-00	33 $\pm 100\%$ 16V electrolytic
C1008	1-105-661-12	0.001 $\pm 10\%$ 50V mylar	C1046	1-107-077-00	47p $\pm 5\%$ 50V silvered mica
	(Se. No. up to 11,850)		C1047	1-107-077-00	47p $\pm 5\%$ 50V silvered mica
	1-105-664-12	0.0018 $\pm 10\%$ 50V mylar (Se. No. 11,851 and later)	C1048	1-101-006-00	0.047 $\pm 100\%$ 50V ceramic
Note: Se. No. means Serial Number			C1049	1-101-004-00	0.01 $\pm 100\%$ 50V ceramic
			C1050	1-101-001-00	0.001 $\pm 100\%$ 50V ceramic
			C1051	1-101-004-00	0.01 $\pm 100\%$ 50V ceramic
			C1052	1-101-006-00	0.047 $\pm 100\%$ 50V ceramic
			C1053	1-121-391-00	1 $\pm 150\%$ 50V electrolytic
			C1054	1-121-413-00	100 $\pm 100\%$ 6.3V electrolytic
			C1055	1-121-391-00	1 $\pm 150\%$ 50V electrolytic
			C1056	1-101-006-00	0.047 $\pm 100\%$ 50V ceramic
			C1057	1-121-415-00	100 $\pm 100\%$ 16V electrolytic
			C1058	1-107-077-00	47p $\pm 5\%$ 50V silvered mica
			C1059	1-107-083-00	82p $\pm 5\%$ 50V silvered mica

<i>Ref. No.</i>	<i>Part No.</i>	<i>Description</i>				<i>Ref. No.</i>	<i>Part No.</i>	<i>Description</i>			
C1060	1-107-089-00	150p	±5%	50V	silvered mica	C1112	1-107-089-00	150p	±5%	50V	silvered mica
C1061	1-107-083-00	82p	±5%	50V	silvered mica	C1113	1-102-736-00	150p	±5%	50V	ceramic
C1062	1-101-006-00	0.047	±100%	50V	ceramic	C1114	1-101-001-00	0.001	±100%	50V	ceramic
C1063	1-107-077-00	47p	±5%	50V	silvered mica	C1115	1-101-006-00	0.047	±100%	50V	ceramic
C1064	1-101-001-00	0.001	±100%	50V	ceramic	C1116	1-101-004-00	0.01	±100%	50V	ceramic
C1065	1-101-001-00	0.001	±100%	50V	ceramic	C1117	1-101-006-00	0.047	±100%	50V	ceramic
C1066	1-101-006-00	0.047	±100%	50V	ceramic	C1118	1-101-006-00	0.047	±100%	50V	ceramic
C1067	1-107-085-00	100p	±5%	50V	silvered mica	C1119	1-121-391-00	1	±150%	50V	electrolytic
C1068	1-101-001-00	0.001	±100%	50V	ceramic	C1120	1-101-006-00	0.047	±100%	50V	ceramic
C1069	1-121-395-00	4.7	±100%	25V	electrolytic	C1121	1-101-004-00	0.01	±100%	50V	ceramic
C1070	1-101-004-00	0.01	±100%	50V	ceramic	C1122		-----			
C1071	1-121-403-00	33	±100%	16V	electrolytic	C1123	1-101-004-00	0.01	±100%	50V	ceramic
C1072	1-101-004-00	0.01	±100%	50V	ceramic	C1124	1-101-006-00	0.047	±100%	50V	ceramic
C1073	1-107-089-00	150p	±5%	50V	silvered mica	C1125	1-121-398-00	10	±100%	25V	electrolytic
C1074	1-101-044-00	0.01	±100%	50V	ceramic	C1126	1-101-006-00	0.047	±100%	50V	ceramic
C1075	1-107-081-00	68p	±5%	50V	silvered mica	C1127		-----			
C1076	1-105-673-12	0.01	±10%	50V	mylar	C1128	1-121-398-00	10	±100%	25V	electrolytic
C1077	1-121-398-00	10	±100%	25V	electrolytic	C1129	1-101-006-00	0.047	±100%	50V	ceramic
C1078	1-121-395-00	4.7	±100%	25V	electrolytic	C1130	1-101-006-00	0.047	±100%	50V	ceramic
C1079	1-121-391-00	1	±150%	50V	electrolytic	C1131	1-121-398-00	10	±100%	25V	electrolytic
C1080	1-121-410-00	47	±100%	25V	electrolytic	C1132	1-101-006-00	0.047	±100%	50V	ceramic
C1081	1-101-001-00	0.001	±100%	50V	ceramic	C1133	1-101-004-00	0.01	±100%	50V	ceramic
C1082	1-101-004-00	0.01	±100%	50V	ceramic	C1134	1-107-097-00	330p	±5%	50V	silvered mica
C1083	1-101-001-00	0.001	±100%	50V	ceramic	C1135	1-107-097-00	330p	±5%	50V	silvered mica
C1084	1-101-006-00	0.047	±100%	50V	ceramic	C1136	1-101-004-00	0.01	±100%	50V	ceramic
C1085	1-107-083-00	82p	±5%	50V	silvered mica	C1137	1-107-087-00	120p	±5%	50V	silvered mica
C1086	1-107-092-00	200p	±5%	50V	silvered mica	C1138	1-107-125-00	56p	±10%	50V	silvered mica
C1087	1-107-083-00	82p	±5%	50V	silvered mica	C1139	1-107-125-00	56p	±10%	50V	silvered mica
C1088	1-121-391-00	1	±150%	50V	electrolytic	C1140	1-107-100-00	3p	±10%	50V	silvered mica
C1089	1-101-004-00	0.01	±100%	50V	ceramic	C1141	1-107-100-00	3p	±10%	50V	silvered mica
C1090	1-107-097-00	330p	±5%	50V	silvered mica	C1142	1-107-061-00	10p	±5%	50V	silvered mica
C1091	1-101-006-00	0.047	±100%	50V	ceramic	C1143	1-107-061-00	10p	±5%	50V	silvered mica
C1092	1-101-006-00	0.047	±100%	50V	ceramic						
C1093	1-107-088-00	130p	±5%	50V	silvered mica	C1401	1-101-006-00	0.047	±100%	50V	ceramic
C1094	1-107-088-00	130p	±5%	50V	silvered mica	C1402	1-121-410-00	47	±100%	25V	electrolytic
C1095	1-101-006-00	0.047	±100%	50V	ceramic	C1403	1-141-130-00	18p			trimmer
C1096	1-101-004-00	0.01	±100%	50V	ceramic	C1404	1-101-004-00	0.01	±100%	50V	ceramic
C1097	1-101-006-00	0.047	±100%	50V	ceramic	C1405	1-101-004-00	0.01	±100%	50V	ceramic
C1098	1-121-391-00	1	±150%	50V	silvered mica	C1406	1-127-203-00	0.33	±20%	16V	solid, aluminum
C1099	1-101-006-00	0.047	±100%	50V	ceramic						
C1100	1-101-004-00	0.01	±100%	50V	ceramic	C1407	1-101-006-00	0.047	±100%	50V	ceramic
C1101		-----				C1408	1-101-006-00	0.047	±100%	50V	ceramic
C1102	1-101-004-00	0.01	±100%	50V	ceramic	C1409	1-101-006-00	0.047	±100%	50V	ceramic
C1103	1-101-006-00	0.047	±100%	50V	ceramic	C1410	1-121-410-00	47	±100%	25V	electrolytic
C1104	1-121-398-00	10	±100%	25V	electrolytic	C1411	1-141-130-00	18p			trimmer
C1105	1-101-006-00	0.047	±100%	50V	ceramic	C1412	1-101-004-00	0.01	±100%	50V	ceramic
C1106		-----				C1413	1-101-004-00	0.01	±100%	50V	ceramic
C1107	1-121-398-00	10	±100%	25V	electrolytic	C1414	1-127-203-00	0.33	±20%	16V	solid, aluminum
C1108	1-101-006-00	0.047	±100%	50V	ceramic						
C1109	1-141-131-00	50p			trimmer	C1415	1-101-006-00	0.047	±100%	50V	ceramic
C1110	1-107-073-00	33p	±5%	50V	silvered mica	C1416	1-101-006-00	0.047	±100%	50V	ceramic
C1111	1-102-758-00	56p	±5%	50V	ceramic						

<i>Ref. No.</i>	<i>Part No.</i>	<i>Description</i>		<i>Ref. No.</i>	<i>Part No.</i>	<i>Description</i>	
C1417	1-105-667-12	0.0033	$\pm 10\%$ 50 V	mylar	C1530	1-101-006-00	0.047 $\pm 100\%$ 50 V ceramic
C1418	1-101-004-00	0.01	$\pm 100\%$ 50 V	ceramic	C1531	1-107-085-00	100p $\pm 5\%$ 50 V silvered mica
C1419	1-101-004-00	0.01	$\pm 100\%$ 50 V	ceramic	C1532	1-107-092-00	200p $\pm 5\%$ 50 V silvered mica
C1420	1-107-085-00	100p	$\pm 5\%$ 50 V	silvered mica	C1533	1-107-085-00	100p $\pm 5\%$ 50 V silvered mica
C1421	1-109-164-00	560p	$\pm 5\%$ 300 V	silvered mica	C1534	1-101-006-00	0.047 $\pm 100\%$ 50 V ceramic
C1422	1-107-085-00	100p	$\pm 5\%$ 50 V	silvered mica	C1535	1-101-006-00	0.047 $\pm 100\%$ 50 V ceramic
C1423	1-107-089-00	150p	$\pm 5\%$ 50 V	silvered mica	C1536	1-107-097-00	330p $\pm 5\%$ 50 V silvered mica
C1424	1-101-006-00	0.047	$\pm 100\%$ 50 V	ceramic	C1537	1-101-006-00	0.047 $\pm 100\%$ 50 V ceramic
C1425	1-101-006-00	0.047	$\pm 100\%$ 50 V	ceramic	C1538	1-105-681-12	0.047 $\pm 10\%$ 50 V mylar
C1426	1-101-004-00	0.01	$\pm 100\%$ 50 V	ceramic	C1539	1-101-006-00	0.047 $\pm 100\%$ 50 V ceramic
C1427	1-101-006-00	0.047	$\pm 100\%$ 50 V	ceramic	C1540	1-121-415-00	100 $\pm 100\%$ 16 V electrolytic
C1428	1-101-006-00	0.047	$\pm 100\%$ 50 V	ceramic	C1541	1-101-006-00	0.047 $\pm 100\%$ 50 V ceramic
C1429	1-105-667-12	0.0033	$\pm 10\%$ 50 V	mylar	C1542	1-107-077-00	47p $\pm 5\%$ 50 V silvered mica
C1430	1-101-006-00	0.047	$\pm 100\%$ 50 V	ceramic	C1543	1-101-006-00	0.047 $\pm 100\%$ 50 V ceramic
C1431	1-101-006-00	0.047	$\pm 100\%$ 50 V	ceramic	C1544	-----	
C1432	1-101-439-00	680p	$\pm 20\%$ 50 V	ceramic	C1545	-----	
C1433	1-121-409-00	47	$\pm 100\%$ 16 V	electrolytic	C1546	1-107-089-00	150p $\pm 5\%$ 50 V silvered mica
C1434	1-102-106-00	100p	$\pm 10\%$ 50 V	ceramic	C1547	1-101-006-00	0.047 $\pm 100\%$ 50 V ceramic
C1435	1-102-106-00	100p	$\pm 10\%$ 50 V	ceramic	C1548	1-101-006-00	0.047 $\pm 100\%$ 50 V ceramic
C1436	1-101-439-00	680p	$\pm 20\%$ 50 V	ceramic	C1549	1-101-006-00	0.047 $\pm 100\%$ 50 V ceramic
C1437	1-121-409-00	47	$\pm 100\%$ 16 V	electrolytic	C1550	1-101-006-00	0.047 $\pm 100\%$ 50 V ceramic
C1438	1-121-409-00	47	$\pm 100\%$ 16 V	electrolytic	C1551	1-102-877-00	33p $\pm 5\%$ 50 V ceramic
					C1552	1-102-877-00	33p $\pm 5\%$ 50 V ceramic
C1501	1-101-004-00	0.01	$\pm 100\%$ 50 V	ceramic	C1553	1-141-131-00	50p trimmer
C1502	1-101-006-00	0.047	$\pm 100\%$ 50 V	ceramic	C1554	1-107-089-00	150p $\pm 5\%$ 50 V silvered mica
C1503	1-101-004-00	0.01	$\pm 100\%$ 50 V	ceramic	C1555	1-102-736-00	150p $\pm 5\%$ 50 V ceramic
C1504	1-101-006-00	0.047	$\pm 100\%$ 50 V	ceramic	C1556	1-101-006-00	0.047 $\pm 100\%$ 50 V ceramic
C1505	1-121-404-00	33	$\pm 100\%$ 25 V	electrolytic	C1557	1-101-001-00	0.001 $\pm 100\%$ 50 V ceramic
C1506	1-101-006-00	0.047	$\pm 100\%$ 50 V	ceramic	C1558	1-101-006-00	0.047 $\pm 100\%$ 50 V ceramic
C1507	1-101-006-00	0.047	$\pm 100\%$ 50 V	ceramic	C1559	1-101-001-00	0.001 $\pm 100\%$ 50 V ceramic
C1508	1-121-391-00	1	$\pm 150\%$ 50 V	electrolytic	C1560	1-101-006-00	0.047 $\pm 100\%$ 50 V ceramic
C1509	1-109-162-00	470p	$\pm 5\%$ 300 V	silvered mica	C1561	1-101-004-00	0.01 $\pm 100\%$ 50 V ceramic
C1510	1-121-398-00	10	$\pm 100\%$ 25 V	electrolytic	C1562	1-101-001-00	0.001 $\pm 100\%$ 50 V ceramic
C1511	1-121-398-00	10	$\pm 100\%$ 25 V	electrolytic	C1563	1-107-089-00	150p $\pm 5\%$ 50 V silvered mica
C1512	1-121-409-00	47	$\pm 100\%$ 16 V	electrolytic	C1564	1-121-391-00	1 $\pm 150\%$ 50 V electrolytic
C1513	1-107-077-00	47p	$\pm 5\%$ 50 V	silvered mica	C1565	1-121-391-00	1 $\pm 150\%$ 50 V electrolytic
C1514	1-121-391-00	1	$\pm 150\%$ 50 V	electrolytic	C1566	1-121-416-00	100 $\pm 100\%$ 25 V electrolytic
C1515	1-121-410-00	47	$\pm 100\%$ 25 V	electrolytic	C1567	1-107-073-00	33p $\pm 5\%$ 50 V silvered mica
C1516	1-121-409-00	47	$\pm 100\%$ 16 V	electrolytic	C1568	1-107-073-00	33p $\pm 5\%$ 50 V silvered mica
C1517	1-121-409-00	47	$\pm 100\%$ 16 V	electrolytic	C1569	1-101-004-00	0.01 $\pm 100\%$ 50 V ceramic
C1518	1-101-006-00	0.047	$\pm 100\%$ 50 V	ceramic	C1570	1-101-004-00	0.01 $\pm 100\%$ 50 V ceramic
C1519	1-101-006-00	0.047	$\pm 100\%$ 50 V	ceramic	C1571	1-101-004-00	0.01 $\pm 100\%$ 50 V ceramic
C1520	1-109-160-00	390p	$\pm 5\%$ 300 V	silvered mica	C1572	1-107-085-00	100p $\pm 5\%$ 50 V silvered mica
C1521	1-121-404-00	33	$\pm 100\%$ 25 V	electrolytic	C1573	1-105-677-12	0.022 $\pm 10\%$ 50 V mylar
C1522	1-101-004-00	0.01	$\pm 100\%$ 50 V	ceramic			
C1523	1-101-006-00	0.047	$\pm 100\%$ 50 V	ceramic	C1582	1-107-079-00	56p $\pm 5\%$ 50 V silvered mica
C1524	1-121-403-00	33	$\pm 100\%$ 16 V	electrolytic	C1583	1-121-409-00	47 $\pm 100\%$ 16 V electrolytic
C1525	1-101-006-00	0.047	$\pm 100\%$ 50 V	ceramic	C1584	1-121-395-00	4.7 $\pm 150\%$ 25 V electrolytic
C1526	1-121-409-00	47	$\pm 100\%$ 16 V	electrolytic	C1585	1-105-661-12	0.001 $\pm 10\%$ 50 V mylar
C1527	1-101-006-00	0.047	$\pm 100\%$ 50 V	ceramic	C1586	1-121-409-00	47 $\pm 100\%$ 16 V electrolytic
C1528	1-101-006-00	0.047	$\pm 100\%$ 50 V	ceramic	C1587	1-105-673-12	0.01 $\pm 10\%$ 50 V mylar
C1529	1-101-006-00	0.047	$\pm 100\%$ 50 V	ceramic	C1588	1-105-673-12	0.01 $\pm 10\%$ 50 V mylar

Ref. No.	Part No.	Description				Ref. No.	Part No.	Description				
C1589	1-121-391-00	1	$\pm 10\%$	50 V	electrolytic	C1641	1-107-232-00	390p	$\pm 5\%$	50 V	silvered mica	
C1590	1-121-398-00	10	$\pm 10\%$	25 V	electrolytic	C1642	1-101-006-00	0.047	$\pm 100\%$	50 V	ceramic	
C1591	1-109-162-00	470p	$\pm 5\%$	300 V	silvered mica	C1643	1-107-087-00	120p	$\pm 5\%$	50 V	silvered mica	
C1592	1-105-665-12	0.0022	$\pm 10\%$	50 V	mylar	C1644	1-107-102-00	5p	$\pm 5\%$	50 V	silvered mica	
C1593	1-121-391-00	1	$\pm 10\%$	50 V	electrolytic	C1645	1-107-093-00	220p	$\pm 5\%$	50 V	silvered mica	
C1594	1-101-006-00	0.047	$\pm 100\%$	50 V	ceramic	C1646	1-107-093-00	220p	$\pm 5\%$	50 V	silvered mica	
C1595	1-101-006-00	0.047	$\pm 100\%$	50 V	ceramic	C1647	1-101-006-00	0.047	$\pm 100\%$	50 V	ceramic	
C1596	1-101-001-00	0.001	$\pm 100\%$	50 V	ceramic	C1648	1-101-006-00	0.047	$\pm 100\%$	50 V	ceramic	
C1597	1-101-044-00	0.1	$\pm 20\%$	50 V	ceramic	(Se. No. 10,251 and later)						
C1598	1-101-006-00	0.047	$\pm 100\%$	50 V	ceramic	C1650	1-107-077-00	47p	$\pm 5\%$	50 V	silvered mica	
C1599	1-121-398-00	10	$\pm 10\%$	25 V	electrolytic	C1651	1-107-079-00	56p	$\pm 5\%$	50 V	silvered mica	
C1600	1-121-391-00	1	$\pm 10\%$	50 V	electrolytic	(Se. No. 10,345 and later)						
C1601	1-101-006-00	0.047	$\pm 100\%$	50 V	ceramic	C1652	1-101-006-00	0.047	$\pm 100\%$	50 V	ceramic	
C1602	1-101-006-00	0.047	$\pm 100\%$	50 V	ceramic	*C1653	1-107-081-00	68p	$\pm 5\%$	50 V	silvered mica	
C1603	1-101-006-00	0.047	$\pm 100\%$	50 V	ceramic		1-107-085-00	100p	$\pm 5\%$	50 V	silvered mica	
C1604	1-121-413-00	100	$\pm 10\%$	6.3 V	electrolytic		1-107-089-00	150p	$\pm 5\%$	50 V	silvered mica	
C1605	1-121-409-00	47	$\pm 100\%$	16 V	electrolytic	C2001	(C2101)	1-121-398-00	10	$\pm 100\%$	25 V	electrolytic
C1606	1-101-006-00	0.047	$\pm 100\%$	50 V	ceramic	C2002		1-102-106-00	100p	$\pm 10\%$	50 V	ceramic
C1607	1-121-409-00	47	$\pm 100\%$	16 V	electrolytic	C2003	(C2103)	1-102-074-00	0.001	$\pm 10\%$	50 V	ceramic
C1608	1-121-413-00	100	$\pm 100\%$	6.3 V	electrolytic	C2004		1-121-413-00	100	$\pm 100\%$	6.3 V	electrolytic
C1609	1-121-398-00	10	$\pm 100\%$	25 V	electrolytic	C2005	(C2105)	1-121-398-00	10	$\pm 100\%$	25 V	electrolytic
C1610	1-107-094-00	240p	$\pm 5\%$	50 V	silvered mica	C2006		1-102-112-00	330p	$\pm 10\%$	50 V	ceramic
C1611	1-121-415-00	100	$\pm 100\%$	16 V	electrolytic	C2007	(C2107)	1-121-409-00	47	$\pm 100\%$	16 V	electrolytic
C1612	1-121-414-00	100	$\pm 100\%$	10 V	electrolytic	C2008		1-105-679-12	0.033	$\pm 10\%$	50 V	mylar
C1613	1-121-398-00	10	$\pm 100\%$	25 V	electrolytic	C2009	(C2109)	1-121-398-00	10	$\pm 100\%$	25 V	electrolytic
C1614	1-121-398-00	10	$\pm 100\%$	25 V	electrolytic	C2010		1-127-093-00	0.47	$\pm 20\%$	25 V	solid, aluminum
C1615	1-121-414-00	100	$\pm 100\%$	10 V	electrolytic	C2011	(C2111)	1-127-093-00	0.47	$\pm 20\%$	25 V	solid, aluminum
C1616	1-121-413-00	100	$\pm 100\%$	6.3 V	electrolytic	C2012		1-121-416-00	100	$\pm 100\%$	25 V	electrolytic
C1617	1-107-065-00	15p	$\pm 5\%$	50 V	silvered mica	C2013	(C2113)	1-121-398-00	10	$\pm 100\%$	25 V	electrolytic
C1618	1-107-085-00	100p	$\pm 5\%$	50 V	silvered mica	C2014		1-121-398-00	10	$\pm 100\%$	25 V	electrolytic
C1619	1-121-398-00	10	$\pm 100\%$	25 V	electrolytic	C2015	(C2115)	1-121-398-00	10	$\pm 100\%$	25 V	electrolytic
C1620	1-121-398-00	10	$\pm 100\%$	25 V	electrolytic	C2017		1-121-409-00	47	$\pm 100\%$	16 V	electrolytic
C1621	1-121-469-00	10	$\pm 100\%$	10 V	electrolytic	C2018	(C2118)	1-102-110-00	220p	$\pm 10\%$	50 V	ceramic
C1622	1-121-415-00	100	$\pm 100\%$	16 V	electrolytic	C2019		1-121-409-00	47	$\pm 100\%$	16 V	electrolytic
C1623	1-121-414-00	100	$\pm 100\%$	10 V	electrolytic	(C2119)						
C1624	1-121-413-00	100	$\pm 100\%$	6.3 V	electrolytic							
C1625	1-121-398-00	10	$\pm 100\%$	25 V	electrolytic							
C1626	1-121-415-00	100	$\pm 100\%$	16 V	electrolytic							
C1627	1-121-403-00	33	$\pm 100\%$	16 V	electrolytic							
C1628	1-121-413-00	100	$\pm 100\%$	6.3 V	electrolytic							
C1629	1-121-420-00	220	$\pm 150\%$	10 V	electrolytic							
C1630	1-121-410-00	47	$\pm 100\%$	25 V	electrolytic							
C1631	1-102-531-00	150p	$\pm 5\%$	50 V	ceramic							
C1632	1-102-531-00	150p	$\pm 5\%$	50 V	ceramic							
C1633	1-102-657-00	150p	$\pm 5\%$	50 V	ceramic							
C1634	1-102-656-00	120p	$\pm 5\%$	50 V	ceramic							
C1635	1-109-170-00	0.001	$\pm 5\%$	300 V	silvered mica							
C1636	1-109-170-00	0.001	$\pm 5\%$	300 V	silvered mica							
C1637	1-101-006-00	0.047	$\pm 100\%$	50 V	ceramic							
C1638	1-107-097-00	330p	$\pm 5\%$	50 V	silvered mica							
C1639	1-101-006-00	0.047	$\pm 100\%$	50 V	ceramic							
C1640	1-107-093-00	220p	$\pm 5\%$	50 V	silvered mica							

Note: * should be selected
Se. No. means Serial Number

<i>Ref. No.</i>	<i>Part No.</i>	<i>Description</i>				<i>Ref. No.</i>	<i>Part No.</i>	<i>Description</i>			
C2020 (C2120)	1-121-398-00	10	$\pm 100\%$	25 V	electrolytic	C2216 (C2316)	1-121-410-00	47	$\pm 100\%$	25 V	electrolytic
C2021 (C2121)	1-121-422-00	220	$\pm 100\%$	25 V	electrolytic (Se. No. up to 11,000)	C2217 (C2317)	1-121-409-00	47	$\pm 100\%$	16 V	electrolytic
	1-121-398-00	10	$\pm 100\%$	25 V	electrolytic (Se. No. 11,001 and later)	C2218 (C2318)	1-121-409-00	47	$\pm 100\%$	16 V	electrolytic
C2022 (C2122)	1-121-398-00	10	$\pm 100\%$	25 V	electrolytic	C2219 (C2319)	1-121-398-00	10	$\pm 100\%$	25 V	electrolytic
C2023 (C2123)	1-121-422-00	220	$\pm 100\%$	25 V	electrolytic (Se. No. up to 11,000)	C2220 (C2320)	1-105-687-12	0.15	$\pm 10\%$	50 V	mylar
	1-121-409-00	47	$\pm 100\%$	16 V	electrolytic (Se. No. 11,001 and later)	C2221 (C2321)	1-121-398-00	10	$\pm 100\%$	25 V	electrolytic
C2024 (C2124)	1-102-110-00	220 p	$\pm 10\%$	50 V	ceramic	C2222 (C2322)	1-105-679-12	0.033	$\pm 10\%$	50 V	mylar
C2025 (C2125)	1-105-675-12	0.015	$\pm 10\%$	50 V	mylar	C2223 (C2323)	1-121-398-00	10	$\pm 100\%$	25 V	electrolytic
C2026 (C2126)	1-121-398-00	10	$\pm 100\%$	25 V	electrolytic	C2224 (C2324)	1-121-422-00	220	$\pm 100\%$	25 V	electrolytic
C2027 (C2127)	1-121-422-00	220	$\pm 100\%$	25 V	electrolytic (Se. No. 11,001 and later)	C2225 (C2325)	1-121-398-00	10	$\pm 100\%$	25 V	electrolytic
C2028 (C2128)	1-121-422-00	220	$\pm 100\%$	25 V	electrolytic (Se. No. 11,001 and later)	C2226 (C2326)	1-121-391-00	1	$\pm 150\%$	50 V	electrolytic
C2201 (C2301)	1-121-398-00	10	$\pm 100\%$	25 V	electrolytic	C2227 (C2327)	1-107-131-00	100 p	$\pm 10\%$	50 V	silvered mica
C2202 (C2302)	1-121-398-00	10	$\pm 100\%$	25 V	electrolytic	C2228 (C2328)	1-102-098-00	470 p	$\pm 20\%$	50 V	ceramic
C2203 (C2303)	1-101-455-00	0.001	$\pm 20\%$	50 V	ceramic	C2229 (C2329)	-----				
C2204 (C2304)	1-121-403-00	33	$\pm 100\%$	16 V	electrolytic	C2230 (C2330)	-----				
C2205 (C2305)	1-121-413-00	100	$\pm 100\%$	6.3 V	electrolytic	C2231 (C2331)	1-105-673-12	0.01	$\pm 10\%$	50 V	mylar
C2206 (C2306)	1-121-403-00	33	$\pm 100\%$	16 V	electrolytic	C2232 (C2332)	1-121-395-00	4.7	$\pm 100\%$	25 V	electrolytic
C2207 (C2307)	1-107-107-00	10 p	$\pm 10\%$	50 V	silvered mica	C2233 (C2333)	1-121-964-00	47	$\pm 20\%$	25 V	electrolytic
C2208 (C2308)	1-101-455-00	0.001	$\pm 20\%$	50 V	ceramic	C2234 (C2334)	1-121-398-00	10	$\pm 100\%$	25 V	electrolytic
C2209 (C2309)	1-105-679-12	0.033	$\pm 10\%$	50 V	mylar	C2235 (C2335)	-----				
C2210 (C2310)	1-121-398-00	10	$\pm 100\%$	25 V	electrolytic	C2236 (C2336)	-----				
C2211 (C2311)	1-121-409-00	47	$\pm 100\%$	16 V	electrolytic	C2237 (C2337)	1-121-398-00	10	$\pm 100\%$	25 V	electrolytic
C2212 (C2312)	1-121-398-00	10	$\pm 100\%$	25 V	electrolytic	C2238	1-127-006-00	1	$\pm 20\%$	16 V	solid aluminum (Se. No. 13,401 and later)
C2213 (C2313)	1-102-098-00	470 p	$\pm 20\%$	50 V	ceramic	C2401	1-121-410-00	47	$\pm 100\%$	25 V	electrolytic (Se. No. up to 19,100)
C2214 (C2314)	1-121-398-00	10	$\pm 100\%$	25 V	electrolytic		1-121-398-00	10	$\pm 100\%$	25 V	electrolytic (Se. No. 19,101 and later)
C2215 (C2315)	1-121-410-00	47	$\pm 100\%$	25 V	electrolytic	C2402	1-105-837-12	0.022	$\pm 20\%$	50 V	mylar (Se. No. up to 19,100)
							1-121-416-00	100	$\pm 100\%$	25 V	electrolytic (Se. No. 19,101 and later)

<u>Ref. No.</u>	<u>Part No.</u>	<u>Description</u>	<u>Ref. No.</u>	<u>Part No.</u>	<u>Description</u>
C2403	1-105-845-12	0.1 $\pm 20\%$ 50 V mylar (Se. No. up to 19,100)	C3027	1-121-413-00	100 $\pm 100\%$ 6.3 V electrolytic
	1-129-763-00	0.033 $\pm 10\%$ 200 V polypropylene (Se. No. 19,101 and later)	C3028	1-105-685-12	0.1 $\pm 10\%$ 50 V mylar
C2404	1-129-709-00	0.0039 $\pm 10\%$ 630 V polypropylene (Se. No. up to 19,100)	C3029	1-101-006-00	0.047 $\pm 100\%$ 50 V ceramic
	1-105-678-12	0.027 $\pm 10\%$ 50 V mylar (Se. No. 19,101 and later)	C3030	1-105-673-12	0.01 $\pm 10\%$ 50 V mylar
C2405	1-141-010-00	30~200p trimmer	C3031	1-121-409-00	47 $\pm 100\%$ 16 V electrolytic
C2406	1-141-010-00	30~200p trimmer	C3032	1-121-391-00	1 $\pm 150\%$ 50 V electrolytic
C2407	1-107-097-00	330p $\pm 5\%$ 50 V silvered mica	C3033	1-121-416-00	100 $\pm 100\%$ 25 V electrolytic
C2408	1-107-097-00	330p $\pm 5\%$ 50 V silvered mica	C3034	1-105-661-12	0.001 $\pm 10\%$ 50 V mylar
* C2409	1-107-177-00	220p $\pm 5\%$ 500 V silvered mica (Se. No. up to 19,100)	C3035	1-105-661-12	0.001 $\pm 10\%$ 50 V mylar
	1-107-185-00	470p $\pm 5\%$ 500 V silvered mica (Se. No. up to 19,100)	C3036	1-105-681-12	0.047 $\pm 10\%$ 50 V mylar
	1-107-188-00	620p $\pm 5\%$ 500 V silvered mica (Se. No. up to 19,100)	C3039	1-121-395-00	4.7 $\pm 150\%$ 25 V electrolytic
	1-129-705-00	0.0018 $\pm 10\%$ 630 V polypropylene (Se. No. 19,101 and later)	C3040	1-121-395-00	4.7 $\pm 150\%$ 25 V electrolytic
	1-121-398-00	10 $\pm 100\%$ 25 V electrolytic (Se. No. up to 19,100)	C3041	1-105-673-12	0.01 $\pm 10\%$ 50 V mylar
C2410	1-121-398-00	10 $\pm 100\%$ 25 V electrolytic (Se. No. up to 19,100)	C3042	1-105-683-12	0.068 $\pm 10\%$ 50 V mylar
C3001	1-121-469-00	10 $\pm 100\%$ 10 V electrolytic	C3043	1-121-469-00	10 $\pm 100\%$ 10 V electrolytic
C3002	1-105-673-12	0.01 $\pm 10\%$ 50 V mylar	C3044	1-101-006-00	0.047 $\pm 100\%$ 50 V ceramic
C3003	1-107-079-00	56p $\pm 5\%$ 50 V silvered mica	C3045	1-105-673-12	0.01 $\pm 10\%$ 50 V mylar
C3004	1-121-413-00	100 $\pm 100\%$ 6.3 V electrolytic	C3046	1-121-395-00	4.7 $\pm 150\%$ 25 V electrolytic
C3005	1-121-391-00	1 $\pm 150\%$ 50 V electrolytic	C3047	1-121-404-00	33 $\pm 100\%$ 25 V electrolytic
C3006	1-121-402-00	33 $\pm 100\%$ 10 V electrolytic	C3048	1-121-392-00	3.3 $\pm 150\%$ 25 V electrolytic
C3007	1-105-685-12	0.1 $\pm 10\%$ 50 V mylar	C3049	1-121-409-00	47 $\pm 100\%$ 16 V electrolytic
C3008	1-105-673-12	0.01 $\pm 10\%$ 50 V mylar	C3050	1-121-404-00	33 $\pm 100\%$ 25 V electrolytic
C3009	1-101-005-00	0.022 $\pm 100\%$ 50 V ceramic	C4001	1-121-415-00	100 $\pm 100\%$ 16 V electrolytic
C3010	1-105-677-12	0.022 $\pm 10\%$ 50 V mylar	C4002	1-127-309-00	22 $\pm 20\%$ 16 V solid, aluminum
C3011	1-105-673-12	0.01 $\pm 10\%$ 50 V mylar	C4003	-----	-----
C3012	1-127-023-00	1 $\pm 20\%$ 10 V solid, aluminum	C4004	1-121-398-00	10 $\pm 100\%$ 25 V electrolytic
C3013	1-105-673-12	0.01 $\pm 10\%$ 50 V mylar	C4005	1-105-673-12	0.01 $\pm 10\%$ 50 V mylar
C3014	1-127-022-00	0.47 $\pm 20\%$ 10 V solid, aluminum	C4006	1-101-001-00	1,000p $\pm 100\%$ 50 V ceramic
C3015	1-121-409-00	47 $\pm 100\%$ 10 V electrolytic	C4007	1-127-021-00	0.33 $\pm 20\%$ 10 V solid, aluminum
C3016	1-105-685-12	0.1 $\pm 10\%$ 50 V mylar	C4008	1-121-402-00	33 $\pm 100\%$ 10 V electrolytic
C3017	1-105-673-12	0.01 $\pm 10\%$ 50 V mylar	C4009	1-127-257-00	10 $\pm 20\%$ 6.3 V solid, aluminum
C3018	1-101-005-00	0.022 $\pm 100\%$ 50 V ceramic	C4010	1-127-257-00	10 $\pm 20\%$ 6.3 V solid, aluminum
C3019	1-105-677-12	0.022 $\pm 10\%$ 50 V mylar	C4011	1-127-309-00	22 $\pm 20\%$ 16 V solid, aluminum
C3020	1-105-673-12	0.01 $\pm 10\%$ 50 V mylar	C4012	1-127-203-00	0.33 $\pm 20\%$ 16 V solid, aluminum
C3021	1-127-022-00	0.47 $\pm 20\%$ 10 V solid, aluminum	C4013	1-121-402-00	33 $\pm 100\%$ 10 V electrolytic
C3023	1-127-022-00	0.47 $\pm 20\%$ 10 V solid, aluminum	C4014	1-105-673-12	0.01 $\pm 10\%$ 50 V mylar
C3024	1-121-420-00	220 $\pm 100\%$ 10 V electrolytic	C4015	1-127-309-00	22 $\pm 20\%$ 16 V solid, aluminum
C3025	1-121-469-00	10 $\pm 100\%$ 10 V electrolytic	C4016	1-101-001-00	1,000p $\pm 100\%$ 50 V ceramic
C3026	1-127-021-00	0.33 $\pm 20\%$ 10 V solid, aluminum	C4017	1-101-001-00	1,000p $\pm 100\%$ 50 V ceramic
			C4018	1-127-309-00	22 $\pm 20\%$ 16 V solid, aluminum
			C4019	1-121-398-00	10 $\pm 100\%$ 25 V electrolytic
			C4020	1-121-392-00	3.3 $\pm 150\%$ 25 V electrolytic

* should be selected.

<u>Ref. No.</u>	<u>Part No.</u>	<u>Description</u>				<u>Ref. No.</u>	<u>Part No.</u>	<u>Description</u>			
C4021	1-101-004-00	0.01	±20%	50V	ceramic	C8202	1-101-002-00	0.0022	±100%	50V	ceramic
R4022	1-242-697-00	10k				C8203	1-101-574-00	2.5p	±0.2pF	50V	ceramic
R4023	1-242-715-00	56k				C8204	1-101-002-00	0.0022	±100%	50V	ceramic
R4024	1-242-705-00	22k				C8205	1-101-002-00	0.0022	±100%	50V	ceramic
R4025	1-242-715-00	56k				C8206	1-101-002-00	0.0022	±100%	50V	ceramic
R4026	1-242-705-00	22k				C8207	1-101-002-00	0.0022	±100%	50V	ceramic
R4027	1-242-719-00	82k				C8208	1-101-058-00	0.0047	±20%	50V	ceramic
C6001	1-102-072-00	130p	±200%	500V	spark gap	C8209	1-101-002-00	0.0022	±100%	50V	ceramic
C6002	1-102-072-00	130p	±200%	500V	spark gap	C8210	1-101-002-00	0.0022	±100%	50V	ceramic
C6003	1-108-779-00	0.01	±20%	250V	MP	C8211	1-105-574-00	2.5p	±0.2pF	50V	ceramic
C6004	1-113-069-00	2.5+1.2	±15%	250V	MP	C8212	1-101-002-00	0.0022	±100%	50V	ceramic
C6005	1-121-074-00	1,000	±150%	50V	electrolytic	C8213	1-101-002-00	0.0022	±100%	50V	ceramic
C6006	1-121-985-00	4,000	±100%	25V	electrolytic	C8214	1-101-002-00	0.0022	±100%	50V	ceramic
C6007	1-105-849-12	0.22	±20%	50V	mylar	C8215	1-101-002-00	0.0022	±100%	50V	ceramic
		(Se. No. up to 11,240)				C8216	1-121-402-00	33	±100%	10V	electrolytic
C6008	1-101-006-00	0.0047	±100%	50V	ceramic	C8217	1-101-002-00	0.0022	±100%	50V	ceramic
		(Se. No. 11,241 and later)				C8218	1-121-402-00	33	±100%	10V	electrolytic
C6101	1-121-405-00	33	±100%	50V	electrolytic	C8219	1-101-574-00	2.5p	±0.2pF	50V	ceramic
C6102	1-121-422-00	220	±100%	25V	electrolytic	C8220	1-101-002-00	0.0022	±100%	50V	ceramic
C6103	1-121-403-00	33	±100%	16V	electrolytic	C8221	1-101-872-00	33p	±5%	50V	ceramic
C6104	1-105-685-12	0.1	±10%	50V	mylar	C8222	1-101-002-00	0.0022	±100%	50V	ceramic
C6105	1-121-395-00	4.7	±150%	25V	electrolytic	C8223	1-102-662-00	7p	±5%	50V	ceramic
C6106	1-121-415-00	100	±100%	16V	electrolytic	C8224	1-102-857-00	6p	±5%	50V	ceramic
C6107	1-101-001-00	0.001	±100%	50V	ceramic	C8225	1-101-002-00	0.0022	±100%	50V	ceramic
C6108	1-101-006-00	0.047	±100%	50V	ceramic	C8226	1-101-002-00	0.0022	±100%	50V	ceramic
C6109	1-105-721-12	0.047	±10%	100V	mylar	C8227	1-121-402-00	33	±100%	10V	electrolytic
C6201	1-121-416-00	100	±100%	25V	electrolytic	C8228	1-101-959-00	10p	±5%	10V	ceramic
C6202	1-121-398-00	10	±100%	25V	electrolytic	C8229	1-101-002-00	0.0022	±100%	50V	ceramic
C6203	1-121-391-00	1	±150%	50V	electrolytic	C8230	1-121-398-00	10	±100%	25V	electrolytic
C6204	1-102-072-00	130p	±200%	500V	ceramic	C8231	1-101-955-00	5p	±0.5pF	50V	ceramic
C6205	1-102-072-00	130p	±200%	500V	ceramic	C8232	1-101-455-00	0.001	±20%	50V	ceramic
C7001	1-101-004-00	0.01	±100%	50V	ceramic	C8233	1-105-717-12	0.022	±20%	100V	mylar
C7002	1-107-061-00	10p	±5%	50V	silvered mica	C8234	1-121-726-00	0.47	±150%	50V	electrolytic
C7003	1-101-004-00	0.01	±100%	50V	ceramic	C8235	1-121-396-00	4.7	±100%	50V	electrolytic
C7004	1-101-004-00	0.01	±100%	50V	ceramic	C8236	1-121-403-00	33	±100%	16V	electrolytic
C7005	1-101-004-00	0.01	±100%	50V	ceramic	C8237	1-101-002-00	0.0022	±100%	50V	ceramic
C7006	1-107-075-00	39p	±5%	50V	silvered mica	C8238	1-121-415-00	100	±100%	16V	electrolytic
C7007	1-107-075-00	39p	±5%	50V	silvered mica	C8239	1-102-940-00	3p	±0.5pF	50V	ceramic
C7008	1-101-004-00	0.01	±100%	50V	ceramic	C8240	1-102-940-00	3p	±0.5pF	50V	ceramic
C7009	1-101-004-00	0.01	±100%	50V	ceramic	C8241	1-102-947-00	10p	±5%	50V	ceramic
C7010	1-102-678-00	100p	±5%	50V	ceramic	C8242	1-102-942-00	5p	±5%	50V	ceramic
C7011	1-101-004-00	0.01	±100%	50V	ceramic	C8243	1-101-004-00	0.01	±100%	50V	ceramic
C7012	1-101-004-00	0.01	±100%	50V	ceramic	C8244	1-101-004-00	0.01	±100%	50V	ceramic
C7013	1-121-402-00	33	±100%	10V	electrolytic	C8245	1-101-455-00	0.001	±20%	50V	ceramic
C7014	1-101-002-00	2,200p	±100%	50V	ceramic	C8246	1-102-101-00	0.0033	±20%	50V	ceramic
C7015	1-102-975-00	100p	±10%	50V	ceramic	C8247					
C7016	1-102-956-00	15p	±10%	50V	ceramic	C8248	1-101-004-00	0.01	±100%	50V	ceramic
C8201	1-102-862-00	3p	±0.5pF	50V	ceramic	C8249	1-121-442-00	1	±100%	50V	electrolytic
Note: should be selected.						C8250	1-121-409-00	47	±100%	16V	electrolytic
Serial No. 10,401 and later						C8251	1-121-409-00	47	±100%	16V	electrolytic
						C8252	1-121-442-00	1	±100%	50V	electrolytic
						C8253	1-101-002-00	0.0022	±100%	50V	ceramic

<u>Ref. No.</u>	<u>Part No.</u>	<u>Description</u>		
C8254	1-121-402-00	33	$\pm 100\%$	10 V electrolytic
C8255	1-121-402-00	33	$\pm 100\%$	10 V electrolytic
C8256	1-105-725-12	0.1	$\pm 10\%$	100 V mylar
C8257		-----		
C8258	1-121-409-00	47	$\pm 100\%$	16 V electrolytic
C8501	1-121-391-00	1	$\pm 150\%$	50 V electrolytic
C8502	1-105-673-12	0.01	$\pm 10\%$	50 V mylar
CV8201	1-141-092-00	5p		cylinder trimmer

RESISTORS

All resistance values are in Ω , $\pm 5\%$, $\frac{1}{4}W$ and carbon type, unless otherwise indicated.

R1001	1-242-705-00	22 k		
R1002	1-242-697-00	10 k		
R1003	1-242-677-00	1.5 k		
R1004	1-242-673-00	1 k		
R1005	1-242-677-00	1.5 k		
R1006	1-242-673-00	1 k		
R1007	1-242-673-00	1 k		
R1008	1-242-697-00	10 k		
R1009	1-242-717-00	68 k		
R1010	1-242-689-00	4.7 k		
R1011	1-242-683-00	2.7 k		
R1012	1-242-653-00	150		
R1013	1-242-673-00	1 k		
R1014	1-242-657-00	220		
R1015	1-242-743-00	820 k		
R1016	1-242-709-00	33 k		
R1017	1-242-677-00	1.5 k		
R1018	1-242-692-00	6.2 k		
R1019	1-242-705-00	22 k		
R1020	1-242-705-00	22 k		
R1021	1-242-697-00	10 k		
R1022	1-242-685-00	3.3 k		
R1023	1-242-697-00	10 k		
R1024	1-242-685-00	3.3 k		
R1025	1-242-675-00	1.2 k		
R1026	1-242-665-00	470		
R1027	1-242-699-00	12 k		
R1028	1-242-677-00	1.5 k		
R1029	1-242-690-00	5.1 k		
R1030	1-242-665-00	470		
R1031	1-242-677-00	1.5 k		
R1032	1-242-673-00	1 k		
R1033	1-242-693-00	6.8 k		
R1034	1-242-661-00	330		
R1035	1-242-673-00	1 k		
R1036	1-221-997-00	2.2 k-(B), adjustable		
R1037	1-242-685-00	3.3 k		
R1039	1-242-724-00	130 k		
R1040	1-242-705-00	22 k		
R1041	1-242-685-00	3.3 k		
R1042	1-242-657-00	220		
R1043	1-242-692-00	6.2 k		
R1044	1-242-681-00	2.2 k		
R1045	1-242-675-00	1.2 k		
R1046	1-242-649-00	100		
R1047	1-242-729-00	220 k		
R1048	1-242-681-00	2.2 k		
R1049	1-242-709-00	33 k		
R1050	1-242-655-00	180		
R1051	1-244-721-00	100 k		
R1052	1-221-997-00	2.2 k-(B), adjustable		
R1053	1-244-673-00	1 k		
R1054	1-244-673-00	1 k		
R1055	1-242-673-00	1 k		
R1056	1-242-659-00	270		
R1057	1-242-689-00	4.7 k		
R1058	1-242-714-00	51 k		
R1059	1-242-689-00	4.7 k		
R1060	1-242-697-00	10 k		
R1061	1-244-703-00	18 k		
R1062	1-242-697-00	10 k		
R1063	1-242-697-00	10 k		
R1064	1-242-673-00	1 k		
R1065	1-242-697-00	10 k		
R1066	1-242-697-00	10 k		
R1067	1-244-703-00	18 k		
R1068	1-244-721-00	100 k		
R1069	1-242-705-00	22 k		
R1070	1-244-668-00	620		
R1071	1-242-679-00	1.8 k		
R1072	1-242-673-00	1 k		
R1073	1-242-673-00	1 k		
R1074	1-242-673-00	1 k		
R1075	1-242-677-00	1.5 k		
R1076	1-221-997-00	2.2 k-(B), adjustable		
R1077	1-242-673-00	1 k		
R1078	1-242-673-00	1 k		
R1079	1-244-871-00	820	$\pm 5\%$ $\frac{1}{2}W$	carbon
R1080	1-242-665-00	470		
R1081	1-242-661-00	330		
R1082	1-242-697-00	10 k		
R1083	1-221-997-00	2.2 k-(B), adjustable		
R1084	1-242-681-00	2.2 k		
R1085	1-242-681-00	2.2 k		
R1086	1-242-661-00	330		
R1087	1-242-677-00	1.5 k		
R1088	1-242-681-00	2.2 k		
R1089	1-221-606-00	100-(B), adjustable		
R1090	1-222-805-00	470-(B), adjustable		

<u>Ref. No.</u>	<u>Part No.</u>	<u>Description</u>	<u>Ref. No.</u>	<u>Part No.</u>	<u>Description</u>
R1091	1-242-681-00	2.2 k	R1141	1-242-673-00	1 k
R1092	1-242-661-00	330	R1142	1-242-689-00	4.7 k
R1093	1-242-677-00	1.5 k	R1143	1-221-978-00	4.7 k-(B), adjustable
R1094	1-242-673-00	1 k	R1144	1-242-690-00	5.1 k
R1095	1-242-714-00	51 k	R1145	1-242-695-00	8.2 k
R1096	1-242-693-00	6.8 k	R1146	1-242-689-00	4.7 k
R1097	1-242-673-00	1 k	R1147	1-242-721-00	100 k
R1098	1-242-649-00	100	R1148	1-242-689-00	4.7 k
R1099	1-242-667-00	560	R1149	1-242-689-00	4.7 k
R1100	1-242-699-00	12 k	R1150	1-242-705-00	22 k
R1101	1-242-709-00	33 k	R1151	1-242-689-00	4.7 k
R1102	1-242-673-00	1 k	R1152	1-242-689-00	4.7 k
R1103	1-242-712-00	43 k	R1153	1-242-681-00	2.2 k
R1104	1-242-712-00	43 k	R1154	1-242-681-00	2.2 k
R1105	1-242-685-00	3.3 k	R1155	1-242-661-00	330
R1106	1-242-649-00	100	R1156	1-242-661-00	330
R1107	1-242-673-00	1 k	R1157	1-242-665-00	470
R1108	1-242-673-00	1 k	R1158	1-242-670-00	750
R1109	1-242-670-00	750	R1159	1-242-659-00	270
R1110	1-242-649-00	100	R1160	1-242-661-00	330
R1111	1-242-670-00	750	R1161	1-221-997-00	2.2 k-(B), adjustable
R1112	1-242-693-00	6.8 k	R1162	1-221-997-00	2.2 k-(B), adjustable
R1113	1-242-715-00	56 k	R1163	1-242-713-00	47 k
R1114	1-242-681-00	2.2 k	R1164	1-242-717-00	68 k
R1115	1-242-701-00	15 k	R1165	1-242-697-00	10 k
R1116	1-242-689-00	4.7 k	R1166	1-242-673-00	1 k
R1117	1-242-673-00	1 k	R1167	1-242-649-00	100
R1118	1-242-668-00	620	R1168	1-242-673-00	1 k
R1119	1-242-677-00	1.5 k	R1169	1-242-693-00	6.8 k
R1120	1-242-687-00	3.9 k	R1170	1-242-697-00	10 k
R1121	1-242-653-00	150	R1171	1-242-697-00	10 k
R1122	1-244-688-00	4.3 k	R1172	1-242-697-00	10 k
R1123	1-244-861-00	330 $\pm 5\%$ $\frac{1}{2}W$ carbon	R1173	1-242-666-00	510
R1124	1-242-673-00	1 k	R1174	1-242-666-00	510
R1125	1-242-699-00	12 k	R1175	1-242-697-00	10 k
R1126	1-242-699-00	12 k	R1176	1-242-666-00	510
R1127	1-242-646-00	75	R1177	1-242-697-00	10 k
R1128	1-242-667-00	560	R1178	1-242-697-00	10 k
R1129	1-244-701-00	15 k (Se. No. up to 13,000)	R1179	1-242-703-00	18 k
	1-244-677-00	1.5 k (Se. No. 13,001 and later)	R1180	1-242-673-00	1 k
R1130	1-244-661-00	330	R1181	1-242-721-00	100 k
R1131	1-242-661-00	330	R1182	1-242-697-00	10 k
R1132	1-242-705-00	22 k (Se. No. up to 13,000)	R1183	1-242-697-00	10 k
	1-242-737-00	470 k (Se. No. 13,001 and later)	R1184	1-222-804-00	1 k-(B), adjustable
R1133	1-242-673-00	1 k	R1185	1-242-673-00	1 k
R1134	1-242-665-00	470	R1186	1-222-804-00	1 k-(B), adjustable
R1135	1-221-978-00	4.7 k-(B), adjustable	R1187	1-242-709-00	33 k
R1136	1-242-745-00	1 M	R1188	1-242-689-00	4.7 k
R1137	1-242-705-00	22 k	R1189	1-242-673-00	1 k
R1138	1-242-695-00	8.2 k	R1190	1-242-661-00	330
R1139	1-242-705-00	22 k	R1191	1-242-661-00	330
R1140	1-242-689-00	4.7 k	R1192	1-242-679-00	1.8 k

Note: Se. No. means Serial Number

<u>Ref. No.</u>	<u>Part No.</u>	<u>Description</u>
R1193	1-242-665-00	470
R1194	1-242-699-00	12 k
R1195	1-221-606-00	100-(B), adjustable
R1196	1-242-689-00	4.7 k
R1197	1-221-986-00	330-(B), adjustable
R1198	1-242-659-00	270
R1199	1-242-647-00	82
R1200	1-242-633-00	22
R1201	1-244-855-00	180 $\pm 5\%$ $\frac{1}{2}W$ carbon
R1202	1-242-665-00	470
R1203	-----	
R1204	1-242-701-00	15 k
R1205	1-242-705-00	22 k
R1206	1-242-657-00	220
R1207	1-242-673-00	1 k
R1208	1-242-688-00	4.3 k
R1209	1-242-713-00	47 k
R1210	1-242-705-00	22 k
R1211	1-242-696-00	9.1 k
R1212	1-242-709-00	33 k
R1213	1-242-697-00	10 k
R1214	1-242-673-00	1 k
R1215	1-242-673-00	1 k
R1216	1-242-709-00	33 k
R1217	1-242-689-00	4.7 k
R1218	1-242-673-00	1 k
R1219	1-242-661-00	330
R1220	1-242-661-00	330
R1221	1-242-665-00	470
R1222	1-242-679-00	1.8 k
R1223	1-121-606-00	100-(B), adjustable
R1224	1-242-699-00	12 k
R1225	1-242-689-00	4.7 k
R1226	1-221-986-00	330-(B), adjustable
R1227	1-242-659-00	270
R1228	1-242-633-00	22
R1229	1-242-647-00	82
R1230	1-244-855-00	180 $\pm 5\%$ $\frac{1}{2}W$ carbon
R1231	1-242-665-00	470
R1232	-----	
R1233	1-242-641-00	47
R1234	1-242-649-00	100
R1235	1-242-709-00	33 k
R1236	1-242-689-00	4.7 k
R1237	1-242-697-00	10 k
R1238	1-242-705-00	22 k
R1239	1-242-666-00	510
R1240	1-244-709-00	33 k
R1401	1-221-979-00	22 k-(B), adjustable
R1402	1-242-649-00	100
R1403	1-242-685-00	3.3 k
R1404	1-242-689-00	4.7 k
R1405	1-242-703-00	18 k

<u>Ref. No.</u>	<u>Part No.</u>	<u>Description</u>
R1406	1-242-680-00	2 k
R1407	1-242-691-00	5.6 k
R1408	1-242-714-00	51 k
R1409	1-242-649-00	100
R1410	1-242-673-00	1 k
R1411	1-221-978-00	4.7 k-(B), adjustable
R1412	1-242-673-00	1 k
R1413	1-242-691-00	5.6
R1414	1-242-680-00	2 k
R1415	1-242-680-00	2 k
R1416	1-221-979-00	22 k-(B), adjustable
R1417	1-242-649-00	100
R1418	1-242-685-00	3.3 k
R1419	1-242-689-00	4.7 k
R1420	1-242-703-00	18 k
R1421	1-242-680-00	2 k
R1422	1-242-691-00	5.6 k
R1423	1-242-714-00	51 k
R1424	1-242-649-00	100
R1425	1-242-673-00	1 k
R1426	1-221-978-00	4.7 k-(B), adjustable
R1427	1-242-673-00	1 k
R1428	1-242-691-00	5.6 k
R1429	1-242-680-00	2 k
R1430	1-242-680-00	2 k
R1431	1-221-997-00	2.2 k-(B), adjustable
R1432	1-242-721-00	100 k
R1433	1-242-673-00	1 k
R1434	1-242-666-00	510
R1435	1-242-673-00	1 k
R1436	1-242-697-00	10 k
R1437	1-242-680-00	2 k
R1438	1-242-691-00	5.6 k
R1439	1-242-673-00	1 k
R1440	1-242-680-00	2 k
R1441	1-242-697-00	10 k
R1442	1-242-680-00	2 k
R1443	1-242-691-00	5.6 k
R1444	1-242-721-00	100 k
R1445	1-222-993-00	220-(B), adjustable
R1446	1-221-997-00	2.2 k-(B), adjustable
R1447	1-242-721-00	100 k
R1448	1-242-673-00	1 k
R1449	1-244-673-00	1 k
R1450	1-242-709-00	33 k
R1451	1-242-685-00	3.3 k
R1452	1-242-713-00	47 k
R1453	1-242-683-00	2.7 k
R1454	1-242-713-00	47 k
R1455	1-242-685-00	3.3 k
R1456	1-242-709-00	33 k
R1501	1-242-721-00	100 k

<u>Ref. No.</u>	<u>Part No.</u>	<u>Description</u>	<u>Ref. No.</u>	<u>Part No.</u>	<u>Description</u>
R1502	1-242-697-00	10 k	R1555	1-222-804-00	1 k-(B), adjustable
R1503	1-242-673-00	1 k	R1556	1-242-725-00	150 k
R1504	1-242-649-00	100	R1557	1-242-697-00	10 k
R1505	1-242-721-00	100 k	R1558	1-242-681-00	2.2 k
R1506	1-242-697-00	10 k	R1559	1-242-681-00	2.2 k
R1507	1-242-673-00	1 k	R1560	1-242-651-00	120
R1508	1-242-649-00	100	R1561	1-242-685-00	3.3 k
R1509	1-242-703-00	18 k	R1562	1-244-737-00	470 k
R1510	1-242-697-00	10 k	R1563	1-242-729-00	220 k
R1511	1-242-661-00	330	R1564	1-242-661-00	330
R1512	1-242-673-00	1 k	R1565	1-242-701-00	15 k
R1513	1-242-727-00	180 k	R1566	1-222-701-00	10 k-(B), adjustable
R1514	1-242-697-00	10 k	R1567	1-242-673-00	1 k
R1515	1-242-677-00	1.5 k	R1568	1-242-719-00	82 k
R1516	1-242-649-00	100	R1569	1-242-697-00	10 k
R1517	1-244-865-00	470 $\pm 5\%$ $\frac{1}{2}W$ carbon	R1570	1-242-681-00	2.2 k
R1518	-----		R1571	1-242-649-00	100
R1519	1-242-688-00	4.3 k	R1572	1-242-673-00	1 k
R1520	1-221-693-00	1 k-(B), adjustable	R1573	1-242-681-00	2.2 k
R1521	1-242-673-00	1 k	R1574	1-242-705-00	22 k
R1522	1-242-663-00	390	R1575	1-242-697-00	10 k
R1523	1-242-695-00	8.2 k	R1576	1-242-653-00	150
R1524	1-242-689-00	4.7 k	R1577	1-242-677-00	1.5 k
R1525	1-242-669-00	680	R1578	1-242-645-00	68
R1526	1-242-665-00	470	R1579	1-242-666-00	510
R1527	1-242-685-00	3.3 k	R1580	2-42-670-00	750
R1528	1-242-729-00	220 k	R1581	1-222-804-00	1 k-(B), adjustable
R1529	1-242-697-00	10 k	R1582	1-242-705-00	22 k
R1530	1-242-665-00	470	R1583	1-242-697-00	10 k
R1531	1-242-665-00	470	R1584	1-242-673-00	1 k
R1532	1-242-653-00	150	R1585	1-242-683-00	2.7 k
R1533	1-242-653-00	150	R1586	1-242-705-00	22 k
R1534	1-242-661-00	330	R1587	1-242-701-00	15 k
R1535	1-242-723-00	120 k	R1588	1-242-657-00	220
R1536	1-242-697-00	10 k	R1589	1-242-673-00	1 k
R1537	1-242-673-00	1 k	R1590	1-242-691-00	5.6 k
R1538	1-242-637-00	33	R1591	1-242-701-00	15 k
R1539	1-242-673-00	1 k	R1592	1-242-705-00	22 k
R1540	1-242-665-00	470	R1593	1-242-673-00	1 k
R1541	1-242-665-00	470	R1594	1-242-677-00	1.5 k
R1542	1-221-663-00	2 k-(B), adjustable	R1595	1-242-725-00	150 k
R1543	1-242-673-00	1 k	R1596	1-242-689-00	4.7 k
R1544	1-242-705-00	22 k	R1597	1-242-673-00	1 k
R1545	1-242-697-00	10 k	R1598	1-242-653-00	150
R1546	1-242-673-00	1 k	R1599	1-242-673-00	1 k
R1547	1-242-697-00	10 k	R1600	1-242-673-00	1 k
R1548	1-242-697-00	10 k	R1601	1-242-721-00	100 k
R1549	1-242-695-00	8.2 k	R1602	1-242-697-00	10 k
R1550	1-242-697-00	10 k	R1603	1-242-681-00	2.2 k
R1551	1-242-697-00	10 k	R1604	1-242-653-00	150
R1552	1-242-697-00	10 k	R1605	1-242-705-00	22 k
R1553	1-242-695-00	8.2 k	R1606	1-242-705-00	22 k
R1554	1-242-673-00	1 k	R1607	1-242-673-00	1 k

<u>Ref. No.</u>	<u>Part No.</u>	<u>Description</u>
R1608	1-242-661-00	330
R1609	1-242-697-00	10 k
R1610	1-242-723-00	120 k
R1611	1-242-723-00	120 k
R1612	1-221-978-00	4.7 k-(B), adjustable
R1613	1-242-689-00	4.7 k
R1614	1-242-713-00	47 k
R1615	1-242-714-00	51 k
R1631	1-244-705-00	22 k
R1632	1-242-719-00	82 k
R1633	1-242-697-00	10 k
R1634	1-242-685-00	3.3 k
R1635	1-242-661-00	330
R1636	1-242-673-00	1 k
R1637	1-242-657-00	220
R1638	1-242-733-00	330 k
R1639	1-242-697-00	10 k
R1640	1-242-687-00	3.9 k
R1641	1-242-665-00	470
R1642	1-242-673-00	1 k
R1643	1-242-697-00	10 k
R1644	1-242-697-00	10 k
R1645	1-242-709-00	33 k
R1646	1-242-701-00	15 k
R1647	1-221-978-00	4.7 k-(B), adjustable
R1648	1-242-685-00	3.3 k
R1649	1-244-673-00	1 k
R1650	1-244-709-00	33 k
R1651	1-242-709-00	33 k
R1652	1-242-705-00	22 k
R1653	1-242-709-00	33 k
R1654	1-242-681-00	2.2 k
R1655	1-242-709-00	33 k
R1656	1-242-681-00	2.2 k
R1657	1-242-695-00	8.2 k
R1658	1-242-697-00	10 k
R1659	1-242-697-00	10 k
R1660	1-242-697-00	10 k
R1661	1-242-697-00	10 k
R1662	1-242-697-00	10 k
R1663	1-242-695-00	8.2 k
R1664	1-242-672-00	910
R1665	1-242-667-00	560
R1666	1-244-865-00	470 $\pm 5\%$ $\frac{1}{2}W$ carbon
R1667	1-221-606-00	100-(B), adjustable
R1668	1-242-672-00	910
R1669	1-242-667-00	560
R1670	1-242-703-00	18 k
R1671	1-242-697-00	10 k
R1672	1-242-677-00	15. k
R1673	1-242-649-00	100
R1674	1-242-705-00	22 k
R1675	1-242-673-00	1 k

<u>Ref. No.</u>	<u>Part No.</u>	<u>Description</u>
R1676	1-242-683-00	2.7 k
R1677	1-242-666-00	510
R1678	1-221-986-00	330-(B), adjustable
R1679	1-242-641-00	47
R1680	1-242-641-00	47
R1681	1-222-805-00	470-(B), adjustable
R1682	1-242-721-00	100 k
R1683	1-242-697-00	10 k
R1684	1-242-666-00	510
R1685	1-242-677-00	1.5 k
R1686	1-242-649-00	100
R1687	1-242-670-00	750
R1688	1-242-675-00	1.2 k
R1689	1-242-673-00	1 k
R1690	1-242-695-00	8.2 k
R1691	1-242-697-00	10 k
R1692	1-242-697-00	10 k
R1693	1-242-697-00	10 k
R1694	1-242-697-00	10 k
R1695	1-242-697-00	10 k
R1696	1-242-695-00	8.2 k
R1697	1-242-673-00	1 k
R1698	1-242-697-00	10 k
R1699	1-242-667-00	560
R1700	1-242-665-00	470
R1701	1-242-661-00	330
R1702	1-242-719-00	82 k
R1703	1-242-667-00	560
R1704	1-242-685-00	3.3 k
R1705	1-242-695-00	8.2 k
R1706	1-244-661-00	330
R1707	1-242-681-00	2.2 k
R1708	1-222-804-00	1 k-(B), adjustable
R1709	1-242-673-00	1 k
R1710	1-242-697-00	10 k
R1711	1-242-667-00	560
R1712	1-242-709-00	33 k
R1713	1-242-705-00	22 k
R1714	1-242-673-00	1 k
R1715	1-242-701-00	15 k
R1716	1-242-691-00	5.6 k
R1717	1-242-661-00	330
R1718	1-244-865-00	470 $\pm 5\%$ $\frac{1}{2}W$ carbon
R1719	1-242-646-00	75
R1720		-----
R1721	1-242-661-00	330
R1722	1-242-661-00	330
* R1723	1-242-699-00	12 k
	1-242-701-00	15 k
	1-242-703-00	18 k
R1724		-----
R1725		-----
R1726	1-222-783-00	47 k-(B), adjustable

Note: * should be selected.

Se. No. means Serial Number

<u>Ref. No.</u>	<u>Part No.</u>	<u>Description</u>		<u>Ref. No.</u>	<u>Part No.</u>	<u>Description</u>	
R1727	1-242-679-00	1.8 k		R2011	1-242-693-00	6.8 k	
R1728	1-242-697-00	10 k		(R2111)			
R1729	1-242-681-00	2.2 k		R2012	1-221-978-00	4.7 k-(B), adjustable	
R1730	1-242-681-00	2.2 k		(R2112)	1-221-844-00	6.8 k-(B), adjustable	(Se. No. up to 11,000)
R1731	1-242-705-00	22 k					(Se. No. 11,001 and later)
R1732	1-242-697-00	10 k		R2013	1-242-729-00	220 k	
R1733	1-242-645-00	68		(R2113)			
R1734	1-242-677-00	1.5 k		R2014	1-242-705-00	22 k	
R1735	1-242-675-00	1.2 k		(R2114)			
R1736	1-242-683-00	2.7 k		R2015	1-242-723-00	120 k	
R1737	1-242-685-00	3.3 k		(R2115)			
R1738	1-242-671-00	820		R2016	1-242-711-00	39 k	
R1739	1-242-661-00	330		(R2116)			
R1740	1-242-731-00	270 k		R2017	1-242-683-00	2.7 k	
R1741	1-242-701-00	15 k		(R2117)			
R1742	1-242-705-00	22 k		R2018	1-242-691-00	5.6 k	
R1743	1-242-707-00	27 k		(R2118)			
R1744	1-242-717-00	68 k		R2019	1-222-701-00	10 k-(B), adjustable	
R1745	1-242-695-00	8.2 k		(R2119)			
R1746	1-242-689-00	4.7 k		R2020	1-242-697-00	10 k	
R1747	1-242-713-00	47 k		(R2120)			
R1748	1-242-663-00	390		R2022	1-242-733-00	330 k	
R1749	1-242-682-00	2.4 k		(R2122)			
R1750	1-244-875-00	1.2 k	±5% ½W carbon	R2023	1-242-705-00	22 k	
R1751	1-242-677-00	1.5 k		(R2123)			
R1752	1-222-804-00	1 k-(B),	adjustable	R2024	1-242-716-00	62 k	
R1753	1-242-677-00	1.5 k		(R2124)			
R1754	1-242-697-00	10 k		R2025	1-242-677-00	1.5 k	
R1756	1-244-653-00	150		(R2125)			
R1757	1-242-669-00	680	(Se. No. 10,345 and later)	R2026	1-242-665-00	470	
R1758	1-242-661-00	330		(R2126)			
R2001	1-242-719-09	82 k,	low-noise	R2027	1-242-713-00	47 k	
(R2101)				(R2127)			
R2002	1-242-697-09	10 k,	low-noise	R2028	1-242-681-00	2.2 k	
(R2102)				(R2128)			
R2003	1-242-713-09	47 k,	low-noise	R2029	1-242-659-00	270	
(R2103)				(R2129)			
R2004	1-242-725-09	150 k,	low-noise	R2030	1-242-681-00	2.2 k	
(R2104)				(R2130)			
R2005	1-242-669-00	680		R2031	1-242-709-00	33 k	Se. No. 11,001 and later
(R2105)				(R2131)			
R2006	1-242-685-00	3.3 k		R2032	1-242-707-00	27 k	(Se. No. up to 11,000)
(R2106)				(R2132)	1-242-679-00	1.8 k	(Se. No. 11,001 and later)
R2007	1-242-661-00	330		R2033	1-242-709-00	33 k	(Se. No. up to 11,000)
(R2107)				(R2133)			
R2008	1-242-713-00	47 k		R2034	1-242-693-00	6.8 k	(Se. No. up to 11,000)
(R2108)				(R2134)	1-242-717-00	68 k	(Se. No. 11,001 and later)
R2009	1-242-717-00	68 k		R2035	1-242-653-00	150	(Se. No. up to 11,000)
(R2109)				(R2135)	1-242-721-00	100 k	(Se. No. 11,001 and later)
R2010	1-242-705-00	22 k		R2036	1-242-649-00	100	(Se. No. up to 11,000)
(R2110)				(R2136)	1-242-700-00	13 k	(Se. No. 11,001 and later)

<u>Ref. No.</u>	<u>Part No.</u>	<u>Description</u>	<u>Ref. No.</u>	<u>Part No.</u>	<u>Description</u>
R2037	1-242-681-00	2.2 k	R2223	1-242-681-00	2.2 k
R2038	1-242-653-00	150	(R2323)		
R2039	1-242-655-00	180	R2224	1-242-709-00	33 k
R2040			(R2324)		
(R2140)	1-242-653-00	150	R2225	1-242-679-00	1.8 k
R2041			(R2325)		
R2042	1-242-649-00	100	R2226	1-242-681-00	2.2 k
(R2142)			(R2326)		
		(Se. No. 11,001 and later)	R2227	1-242-667-00	560
R2201	1-244-713-09	47 k, low-noise	(R2327)		
(R2301)			R2228	1-221-979-00	22 k-(B), adjustable
R2202	1-242-699-09	12 k, low-noise	(R2328)		
(R2302)			R2229	1-242-697-00	10 k
R2203	1-242-713-09	47 k, low-noise	(R2329)		
(R2303)			R2230	1-242-705-00	22 k
R2204	1-242-713-09	47 k, low-noise	(R2330)		
(R2304)			R2231	1-242-729-00	220 k
R2205	1-242-697-09	10 k, low-noise	(R2331)		
(R2305)			R2232	1-242-709-00	33 k
R2206	1-242-679-00	1.8 k	(R2332)		
(R2306)			R2233	1-242-689-00	4.7 k
R2207	1-242-685-00	3.3 k	(R2333)		
(R2307)			R2234	1-242-673-00	1 k
R2208	1-242-731-00	270 k	(R2334)		
(R2308)			R2235	1-221-606-00	100-(B), adjustable
R2209	1-242-713-00	47 k	(R2335)		
(R2309)			R2236	1-242-649-00	100
R2210	1-242-717-09	68 k, low-noise	(R2336)		
(R2310)			R2237	1-242-697-00	10 k
R2211	1-242-697-00	10 k	(R2337)		
(R2311)			R2238	1-242-697-00	10 k
R2212	1-242-703-00	18 k	(R2338)		
(R2312)			R2239	1-242-721-00	100 k
R2213	1-242-649-00	100	(R2339)		
(R2313)			R2240	1-242-667-00	560
R2214	1-242-683-00	2.7 k	(R2340)		
(R2314)			R2241	1-242-681-00	2.2 k
R2215	1-242-729-00	220 k	(R2341)	1-242-703-00	18 k
(R2315)			R2242	1-242-717-00	68 k
R2216	1-242-697-00	10 k	R2243	1-242-697-00	10 k
(R2316)			(R2343)		
R2217	1-221-979-00	22 k-(B), adjustable	R2244		-----
(R2317)			(R2344)	1-242-709-00	33 k
R2218	1-242-697-00	10 k	R2245		-----
(R2318)	1-242-679-00	1.8 k	(R2345)		
R2219	1-242-731-00	270 k	R2246	1-242-697-00	10 k
(R2319)			R2247	1-242-679-00	1.8 k
R2220	1-242-707-00	27 k	R2248	1-242-703-00	18 k
(R2320)			R2249	1-221-979-00	22 k-(B), adjustable
R2221	1-242-723-00	120 k	R2250	1-242-697-00	10 k
(R2321)			R2251		-----
R2222	1-242-675-00	1.2 k	R2252	1-242-709-00	33 k
(R2322)			R2253	1-242-703-00	18 k

Note: Se. No. means Serial Number

<u>Ref. No.</u>	<u>Part No.</u>	<u>Description</u>	<u>Ref. No.</u>	<u>Part No.</u>	<u>Description</u>
R2401	1-222-805-00	470-(B), adjustable (Se. No. up to 19,100)	R3033	1-242-709-00	33 k
	1-209-044-00	100 $\pm 5\%$ 1W (Se. No. 19,101 and later)	R3034	1-221-979-00	22 k-(B), adjustable
R2402	1-242-701-00	15 k	R3035	1-242-689-00	4.7 k
R2403	1-242-697-00	10 k	R3036		-----
R2404	1-242-697-00	10 k (Se. No. up to 19,100)	R3037	1-222-783-00	47 k-(B), adjustable
	1-242-705-00	22 k (Se. No. 19,101 and later)	R3038	1-242-712-00	43 k
R2405	1-242-663-00	390 (Se. No. up to 19,100)	R3039	1-242-665-00	470
	1-242-683-00	2.7 k (Se. No. 19,101 and later)	R3040	1-244-875-00	1.2 k $\pm 5\%$ $\frac{1}{2}W$ carbon
R2406	1-244-825-00	10 $\pm 5\%$ $\frac{1}{2}W$ carbon (Se. No. up to 19,100)	R3041	1-242-705-00	22 k
	1-242-675-00	1.2 k (Se. No. 19,101 and later)	R3042	1-242-709-00	33 k
R2407	1-244-825-00	10 $\pm 5\%$ $\frac{1}{2}W$ carbon (Se. No. up to 19,100)	R3043	1-242-709-00	33 k
	1-242-625-00	10 (Se. No. 19,101 and later)	R3044	1-242-709-00	33 k
R2408	1-242-625-00	10 (Se. No. 19,101 and later)	R3045	1-242-675-00	1.2 k
R2502	1-242-667-00	560	R3046	1-242-659-00	270
R3001	1-242-709-00	33 k	R3047	1-242-693-00	6.8 k
R3002	1-242-705-00	22 k	R3048	1-242-697-00	10 k
R3003	1-242-715-00	56 k	R3049	1-242-709-00	33 k
R3004	1-242-685-00	3.3 k	R3050	1-242-689-00	4.7 k
R3005	1-242-679-00	1.8 k	R3051	1-242-663-00	390
R3006	1-242-737-00	470 k	R3052	1-242-643-00	56 k
R3007	1-242-689-00	4.7 k	R3053	1-242-697-00	10 k
R3008	1-242-703-00	18 k	R3054	1-242-697-00	10 k
R3009	1-244-881-00	2.2 k $\pm 5\%$ $\frac{1}{2}W$ carbon	R3055	1-242-697-00	10 k
R3010	1-242-717-00	68 k	R3056	1-242-683-00	2.7 k
R3011	1-242-689-00	4.7 k	R3057		-----
R3012	1-242-689-00	4.7 k	R3058	1-222-845-00	100 k-(B), adjustable
R3013	1-242-709-00	33 k	R3059	1-242-709-00	33 k
R3014	1-222-783-00	47 k-(B), adjustable	R3060	1-242-683-00	2.7 k
R3015	1-242-693-00	6.8 k	R3061	1-242-709-00	33 k
R3016	1-242-709-00	33 k	R3062	1-242-709-00	33 k
R3017	1-242-783-00	47 k-(B), adjustable	R3063	1-242-685-00	3.3 k
R3018	1-242-691-00	5.6 k	R3064	1-242-689-00	4.7 k
R3019	1-242-709-00	33 k	R3065	1-242-689-00	4.7 k
R3020	1-222-783-00	47 k-(B), adjustable	R3066	1-242-665-00	470
R3021	1-242-691-00	5.6 k	R3067	1-242-707-00	27 k
R3022	1-242-687-00	3.9 k	R3068	1-242-705-00	22 k
R3023	1-242-697-00	10 k	R3069	1-242-709-00	33 k
R3024	1-242-699-00	12 k	R3070	1-242-689-00	4.7 k
R3025	1-242-701-00	15 k	R3071	1-242-709-00	33 k
R3026	1-244-881-00	2.2 k $\pm 5\%$ $\frac{1}{2}W$ carbon	R3072	1-242-697-00	10 k
R3027	1-242-717-00	68 k	R3073	1-242-715-00	56 k
R3028	1-242-689-00	4.7 k	R3074	1-242-703-00	18 k
R3029	1-242-689-00	4.7 k	R3075	1-242-673-00	1 k
R3030	1-242-709-00	33 k	R3076	1-242-677-00	1.5 k
R3031	1-222-783-00	47 k-(B), adjustable	R3077	1-242-697-00	10 k
R3032	1-242-693-00	6.8 k	R3078	1-242-673-00	1 k
			R3079	1-222-845-00	100 k-(B), adjustable
			R3080	1-222-845-00	100 k-(B), adjustable
			R3081	1-242-713-00	47 k
			R3082	1-242-707-00	27 k
			R3083	1-242-697-00	10 k
			R3084	1-242-691-00	5.6 k
			R3085	1-242-713-00	47 k

Note: Se. No. means Serial Number

<i>Ref. No.</i>	<i>Part No.</i>	<i>Description</i>		<i>Ref. No.</i>	<i>Part No.</i>	<i>Description</i>	
R3086	1-242-731-00	270 k		R4041	1-242-705-00	22 k	
R3087	1-242-699-00	12 k		R4042	1-242-721-00	100 k	
R3088	1-242-705-00	22 k		R4043	1-242-691-00	5.6 k	
R3089	1-242-717-00	68 k		R4044	1-242-691-00	5.6 k	
R3090	1-242-707-00	27 k		R4045	1-242-715-00	56 k	
R3091	1-242-697-00	10 k		R4046	1-242-705-00	22 k	
R3092	1-242-691-00	5.6 k		R4047	1-242-715-00	56 k	
R3093	1-244-721-00	100 k		R4048	1-222-845-00	100 k-(B), $\pm 25\%$	adjustable
R4001	1-242-649-00	100		R4049	1-242-691-00	5.6 k	
R4002	1-242-691-00	5.6 k		R4050	1-242-719-00	82 k	
* R4003	1-206-457-00	5.6	$\pm 5\%$ 2W metal-oxide	R4051	1-242-719-00	82 k	
	1-206-463-00	10	$\pm 5\%$ 2W metal-oxide	R4052	1-242-715-00	56 k	
	1-206-457-00	5.6	$\pm 5\%$ 2W metal-oxide	R4053	1-206-642-00	120	$\pm 5\%$ 2W metal-oxide
R4004	1-242-691-00	5.6 k		R4054	1-242-719-00	82 k	
R4005	1-242-691-00	5.6 k		R4055	1-242-719-00	82 k	
R4006	1-242-705-00	22 k		R4056	1-242-715-00	56 k	
R4007	1-242-719-00	82 k		R4057	1-242-691-00	5.6 k	
R4008	1-242-691-00	5.6 k		R4058	1-242-719-00	82 k	
R4009	1-242-719-00	82 k		R4059	1-242-719-00	82 k	
R4010	1-242-715-00	56 k		R4060	1-242-719-00	82 k	
R4011	1-242-719-00	82 k		R4061	1-242-715-00	56 k	
R4012	1-242-719-00	82 k		R4062	1-242-691-00	5.6 k	
R4013	1-242-715-00	56 k		R4063	1-242-705-00	22 k	
R4014	1-242-719-00	82 k		R4064	1-242-715-00	56 k	
R4015	1-242-673-00	1 k		R4065	1-242-697-00	10 k	
R4016	1-242-719-00	82 k		R4066	1-242-693-00	6.8 k	
R4017	1-242-715-00	56 k		R4067	1-242-721-00	100 k	
R4018	1-242-691-00	5.6 k		R4068	1-242-689-00	4.7 k	
R4019	1-242-719-00	82 k		R4069	1-242-717-00	68 k	
R4020	1-242-715-00	56 k		R4070	1-242-709-00	33 k	
R4021	1-242-691-00	5.6 k		R4071	1-242-689-00	4.7 k	
R4022	1-242-697-00	10 k		R4072	1-242-677-00	1.5 k	
R4023	1-242-715-00	56 k		R4073	1-242-729-00	220 k	
R4024	1-242-705-00	22 k		R4074	1-242-689-00	4.7 k	
R4025	1-242-715-00	56 k		R4075	1-242-709-00	33 k	
R4026	1-242-705-00	22 k		R4076	1-242-667-00	560	
R4027	1-242-719-00	82 k		* R4077	1-242-731-00	270 k	
R4028	1-242-691-00	5.6 k			1-242-732-00	300 k	
R4029	1-242-691-00	5.6 k		R4078	1-242-717-00	68 k	
R4030	1-242-715-00	56 k		R4079	1-242-689-00	4.7 k	
R4031	1-242-721-00	100 k		R4080	1-242-697-00	10 k	
R4032	1-242-715-00	56 k		R4081	1-242-715-00	56 k	
R4033	1-242-709-00	33 k		R4082	1-242-715-00	56 k	
R4034	1-242-719-00	82 k		R4083	1-242-697-00	10 k	
R4035	1-242-689-00	4.7 k		R4084	1-242-725-00	150 k	
R4036	1-242-695-00	8.2 k		R4085	1-242-691-00	5.6 k	
* R4037	1-242-720-00	91 k		R4086	1-242-709-00	33 k	
	1-242-721-00	100 k		R4087	1-242-705-00	22 k	
	1-242-722-00	110 k		R4088	1-242-691-00	5.6 k	
	1-242-723-00	120 k		R4089	1-242-723-00	120 k	
R4038	1-242-709-00	33 k					
R4039	1-242-717-00	68 k					
R4040	1-242-689-00	4.7 k		R6001	1-242-646-00	75	

* should be selected

<i>Ref. No.</i>	<i>Part No.</i>	<i>Description</i>	<i>Ref. No.</i>	<i>Part No.</i>	<i>Description</i>
R6002	1-242-691-00	5.6 k (Se. No. up to 11,000)	R8206	1-244-651-00	120
	1-244-698-00	11 k (Se. No. 11,001 and later)	R8207	1-244-671-00	820
R6003	1-242-693-00	6.8 k (Se. No. up to 11,000)	R8208	1-244-673-00	1 k
	1-242-630-00	16 (Se. No. 11,001 and later)	R8209	1-244-666-00	510
R6004	1-242-691-00	5.6 k (Se. No. up to 11,000)	R8210	1-244-685-00	3.3 k
	1-244-698-00	11 k (Se. No. 11,001 and later)	R8211	1-244-651-00	120
R6005	1-242-693-00	6.8 k (Se. No. up to 11,000)	R8212	1-244-679-00	1.8 k
	1-242-630-00	16 (Se. No. 11,001 and later)	R8213	1-244-667-00	560
R6006	1-222-696-00	100 k-(B), variable with switch (TRACKING)	R8214	1-244-689-00	4.7 k
R6007	1-222-695-00	1 k-(B), variable with switch (COLOR LOCK)	R8215	1-244-695-00	8.2 k
R6008	1-244-729-00	220 k	R8216	1-244-675-00	1.2 k
			R8217	1-244-691-00	5.6 k
R6101	1-242-695-00	8.2 k	R8218		-----
R6102	1-242-677-00	1.5 k	R8219	1-244-699-00	12 k
R6103	1-242-669-00	680	R8220	1-244-657-00	220
R6104	1-222-804-00	1 k-(B), adjustable	R8221	1-244-671-00	820
R6105	1-242-669-00	680	R8222	1-244-673-00	1 k
R6106	1-242-671-00	820	R8223	1-244-649-00	100
R6107	1-209-044-00	100	R8224	1-244-721-00	100 k
R6108	1-242-669-00	680	R8225	1-244-665-00	470
R6109	1-242-663-00	390	R8226	1-244-661-00	330
R6110	1-221-997-00	2.2 k-(B), adjustable	R8227	1-244-683-00	2.7 k
R6111	1-242-683-00	2.7 k	R8228	1-244-689-00	4.7 k
R6112	1-242-676-00	1.3 k	R8229	1-244-705-00	22 k
R6113	1-242-669-00	680	R8230	1-244-649-00	100
R6114	1-222-804-00	1 k-(B), adjustable	R8231	1-244-649-00	100
R6115	1-242-669-00	680	R8232	1-244-643-00	56
			R8233	1-244-673-00	1 k
R6201	1-244-681-00	2.2 k	R8234	1-244-663-00	390
R6202	1-244-681-00	2.2 k	R8235	1-244-697-00	10 k
R6203	1-244-739-00	560 k	R8236	1-244-687-00	3.9 k
R6204	1-244-739-00	560 k	R8237	1-244-705-00	22 k
R6205	1-244-646-00	75	R8238	1-244-649-00	100
R6206	1-210-583-00	36 $\pm 5\%$ $\frac{1}{2}W$ carbon	R8239	1-206-055-00	100 $\pm 10\%$ 2W metal-oxide
			R8240	1-206-085-00	220 $\pm 10\%$ 1W metal-oxide
R7001	1-242-649-00	100	R8241	1-206-126-00	390 $\pm 10\%$ 2W metal-oxide
R7002	1-242-711-00	39 k	R8242	1-244-697-00	10 k
R7003	1-242-697-00	10 k	R8243	1-244-705-00	22 k
R7004	1-242-673-00	1 k	R8244	1-242-687-00	3.9 k
R7005	1-242-649-00	100	R8245		-----
R7006	1-242-701-00	15 k	R8246	1-244-665-00	470
R7007	1-242-697-00	10 k	R8247	1-242-717-00	68 k
R7008	1-242-673-00	1 k	R8248	1-244-705-00	22 k
R7009	1-242-673-00	1 k	R8249	1-244-673-00	1 k
R7010	1-222-701-00	10 k-(B), adjustable	R8250	1-244-511-00	39 k
			R8251	1-244-858-00	240 $\frac{1}{2}W$
R8201	1-244-703-00	18 k	R8252	1-244-693-00	6.8 k
R8202	1-244-624-00	9.1	R8253	1-244-649-00	100
R8203	1-244-637-00	33	R8254	1-244-697-00	10 k
R8204	1-244-660-00	300	R8255	1-244-659-00	270
R8205	1-244-677-00	1.5 k	R8256	1-244-673-00	1 k
			R8257	1-244-649-00	100
			R8258	1-244-673-00	1 k

<u>Ref. No.</u>	<u>Part No.</u>	<u>Description</u>
R8259	1-244-691-00	5.6 k
R8260	1-244-673-00	1 k
R8261	-----	
R8262	1-244-665-00	470
R8263	1-244-689-00	4.7 k
R8264	1-244-659-00	270
R8265	-----	
R8266	1-244-695-00	8.2 k
R8267	1-244-669-00	680
R8503	1-244-637-00	33
R8504	1-244-701-00	15 k
R8505	1-244-697-00	10 k
R8506	1-244-697-00	10 k
R8507	1-244-701-00	15 k
R8508	1-244-709-00	33 k
R8509	-----	
R8510	1-244-673-00	1 k
VR6201	1-222-805-00	470-(B), adjustable (tuner agc)
VR6202	1-221-986-00	330-(B), adjustable (SND REJ)
VR6203	1-222-804-00	1 k-(B), adjustable (agc)

SWITCHES

S6001	1-514-140-00	switch, push (POWER)
S6002	1-514-674-00	switch, slide (STOP)
S6003	1-514-673-00	switch, slide (PLAY)
S6004	1-514-674-00	switch, slide (F. FWD)
S6005	1-514-674-00	switch, slide (REWIND)
S6006	1-514-932-00	switch, slide (antenna switch)
S6007	-----	
S6008	1-514-941-00	switch, slide (CHANNEL SELECTOR)
S6009	1-514-039-00	switch, micro (cassette in switch)
S6010	1-514-730-00	switch, micro (threading switch)
S6011	1-514-730-00	switch, micro (threading switch)
S6012	1-514-730-00	switch, micro (ac motor build-up switch)
S6013	1-514-693-00	switch, slide (Se. No. up to 11,000) (VHF AUDIO SELECTOR)
	1-516-039-00	switch, slide (Se. No. 11,001 and later) (AUDIO SELECTOR)
S6014	1-514-459-00	switch, slide (MONITOR SELECTOR)
S6015	-----	
S6016	1-514-730-12	switch, micro (record safety switch)

S6017	1-514-964-00	switch, slide (RECORD BUTTON)
S6018	1-514-964-00	switch, slide (AUDIO/DUB)
S6019	1-514-803-00	switch, slide (RECORD BUTTON)
S6020	1-514-730-12	switch, micro (record/dubbing)
S6021	1-514-449-00	switch, slide (Se. No. 11,001 and later) (HEADPHONE LEVEL)
S6201	1-514-963-11	switch, lever/slide (INPUT SIGNAL SELECTOR)

FILTERS

FL1501	1-231-178-00	filter, band-pass (B); 3.58 MHz
FL1502	1-231-179-00	filter, band-pass (C); 4.27 MHz
FL1503	1-231-180-00	filter, low-pass (B)
FL6001	1-231-183-00	filter, band-pass; 3.58 MHz
FL6002	1-231-182-00	filter, low-pass

MISCELLANEOUS

CP4001	1-101-534-00	encapsulated component, 0.1 μ F + 120 Ω
CP4006		
	1-454-085-00	solenoid, C
PM6001	1-454-085-00	solenoid, B
PM6002		
CN6010	1-506-186-12	phono plug, 2-P
CN6011		
CN6208		
CN6209		
CN6210		
CN6012	1-507-251-00	jack, mini (Se. No. 11,001 and later)
CN6013	1-507-282-00	jack, HEADPHONE (Se. No. 11,001 and later)
CN6007	1-507-142-00	phono jack, 2-P
CN6201	1-507-142-13	phono jack, 2-P
CN6202	1-507-251-00	jack (mini)
CN6203		
CN6211	1-507-359-00	phono jack
CN6212		
CN6206	1-508-033-12	housing (red), amplok
CN6207	1-508-033-20	housing (white), amplok
CN6001	1-508-379-11	AC input connector, 3-P

Note: Se. No. means Serial Number

<u>Ref. No.</u>	<u>Part No.</u>	<u>Description</u>	<u>Ref. No.</u>	<u>Part No.</u>	<u>Description</u>
CN6005)	1-509-502-21	output connector, COAXIAL cable	X1501	1-527-186-00	crystal
CN6204			X1001	1-527-190-00	crystal, osc (4.26 MHz)
CN6002	1-509-332-11	AC socket, 3-P	F6101	1-532-118-12	fuse 1.6A
CN6004	1-509-462-11	input connector COAXIAL cable	F6102	1-532-120-12	fuse 2.5A
RY4002	1-515-125-00	relay	F6001	1-532-298-00	fuse 2.0A
RY4003	1-515-125-00	relay		1-533-048-00	fuse post
RY1401	1-515-148-11	relay			
RY1402	1-515-148-11	relay		1-536-080-11	pincontact, amplok
RY2001	1-515-148-00	relay	CN6205	1-536-269-13	terminal strip (ANTENNA)
RY2101	1-515-148-00	relay		1-536-296-00	terminal strip, 1L2L1
RY4001	1-515-149-00	relay	CN6003	1-536-328-00	antenna terminal
CN6006	1-517-051-00	socket, photo transistor lamp		1-536-329-00	terminal strip, 14-P
PL6001	1-518-082-00	lamp, pilot (2V/100 mA); POWER		1-581-248-11	board, T
PL6002	1-518-140-00	lamp, pilot (14 V/80mA); STAND BY (Se. No. 10,920 and later)		1-581-404-00	board, W
	1-518-082-00	lamp, pilot (2 V/100mA); STAND BY (Se. No. up to 10,919)		8-825-520-00	ERASE HEAD
PL6201	1-518-082-00	lamp, pilot (2V/100 mA) TUNING METER	RPH	8-829-158-30	AUDIO/CTL HEAD (Se. No. up to 11,386)
PL6003	1-518-118-00	lamp, photo transistor (6V/200 mA); PHOTO TRANSISTOR		8-829-158-32	AUDIO/CTL HEAD (Se. No. 11,387 and later)
	1-520-109-00	meter, tuning	M6001	8-831-634-20	AC motor
PL6004	1-518 082-12	lamp, pilot (2V/100 mA); RECORD	M6002	8-834-016-01	DC motor
				X-36320-01-0	connector, intermediary; VHF

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SUPPLEMENT 2

This supplement updates the service manual to include mechanical changes and latest jig part numbers. File this supplement with service manual.

1. Jig Part Number Changed

A number of changes have been made to the adjustment jigs since the original set, and some jigs, such as the dummy reel packs and the tools for bending the tension arms, have been added.

All previously-issued jigs, with the exception of the Tension Arm Position Jig TD-530, remain applicable. The TD-530 jig is to be used on machines having serial numbers above 11,000.

Code numbers are stamped on the jigs to facilitate identification.

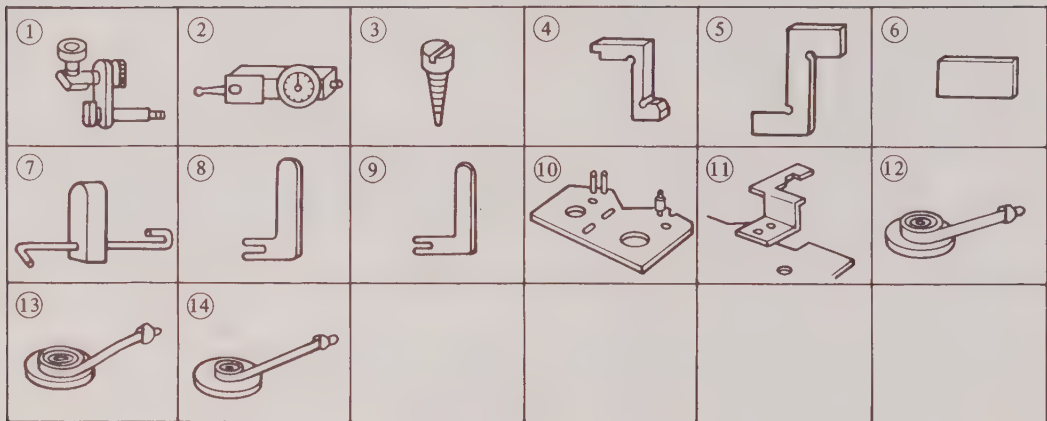
New jigs are marked with an asterisk.

The Tension Arm Position Jig TD-530 is used as shown in Section 5-15 except that the Tension Arm (S) Tape Guide should fit into the notch on the jig.

JIGS REQUIRED FOR MECHANICAL ADJUSTMENTS

Description	Part No.		Jig Code No.	Reference Sketch No.
	Former	New		
Upper Head Drum Alignment Jig	X-03261-04-0 VA-0052	3-702-211-01	TD-052	①
Eccentricity Gauge (should be used with upper head drum alignment jig)		7-732-040-10		②
Dihedral Adjustment Screws (4)	0-324-059-00 VA-0051	3-702-210-01	TD-051	③
Reel-Table Height Adjustment Jig	0-328-121-01 VA-0047	3-702-207-01	TD-047	④
Tension-Arm Height Adjustment Jig	0-328-091-00 VA-0017	3-702-206-01	TD-046	⑤
Audio/Control Head Adjustment Jig	0-328-067-00 VA-0004	3-702-201-01	TD-004	⑥
Threading Ring Drive Pulley Retraction Jig	0-327-170-00	3-702-222-01	TD-513	⑦
*Tension Arm T Bending Jig	0-328-108-00 VA-0027	3-702-204-01	TD-027	⑧
*Tension Arm S Bending Jig	0-328-107-00 VA-0026	3-702-203-01	TD-026	⑨
Back Tension Adjustment Jig	X-03282-41-0 VA-0058	3-702-216-01	TD-058	⑩
*Tension Arm Position Jig	X-36322-44-0 VA-0049	3-702-224-01	TD-530	⑪
Dummy Reel Pack (100 mm dia) (reel table torque adj.)	VA-0056	3-702-215-01	TD-056	⑫
Dummy Reel Pack (118 mm dia) (forward back tension adj.)	VA-0055	3-702-214-01	TD-055	⑬
Dummy Reel Pack (39 mm dia) (forward back tension adj.)	VA-0054	3-702-213-01	TD-054	⑭

JIG SKETCHES

**2. Mechanical Parts Changed**

All mechanical changes are shown in Exploded Views.
See pages 12-1 to 12-13.

3. Correction of Supplement 1 issued July '72.

Page 2 Part number of D board complete 8-985-302-00 → 8-985-304-00

SUPPLEMENT 1

MODEL VO-1600
July, '72

This supplement updates the service manual to include production changes on circuit or printed circuit boards.

1. A-R BOARD MODIFICATIONS

(a) Parts Added

Ref. No.	Description	Applicable Serial No.	Remarks
C648	0.047µF 50V, ceramic (1-101-006-00)	10,151 and later	See Fig. 1-a See Fig. 1-b
C651	56pF ±5% 50V, silvered mica (1-107-079-00)		
R757	680 ohm ±5% ¼W, carbon (1-242-669-00)	10,345 and later	See Fig. 1-a See Fig. 1-c

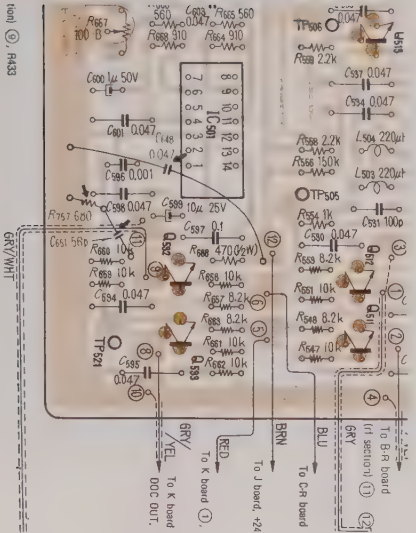


Fig. 1-a

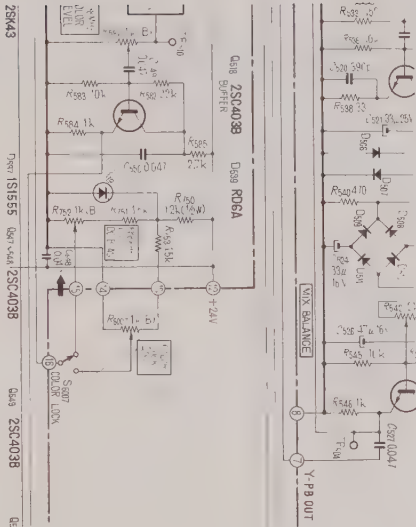


Fig. 1-b

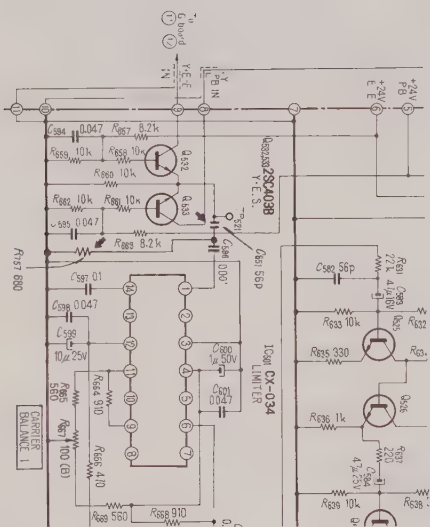
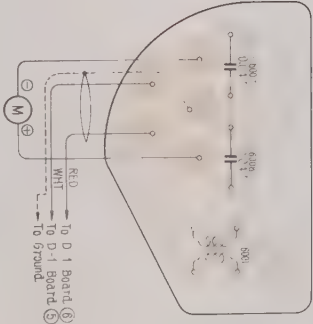


Fig. 1-c

2. M BOARD CHANGED (Serial No. 11,241 and later)

Filter circuit and printed circuit board changed.

New Board (Part No. X-36302-99-1)



3. "D" BOARD (System Control) CHANGED TO "D-1" BOARD

"D" and "Y" boards were combined and changed to "D-1" board with some circuit modifications as shown on pages 4 and 5.

Applicable Serial Numbers 10,401 and later

D board, complete 8-985-304-00 → D-1 board 8-985-304-10
Y board, complete
Note: D-1 board parts list is given on page 10.

4. C-R, N and VHF/AUDIO SWITCH BOARDS CHANGED

These three boards changed due to additional Audio Monitor circuit and Headphone jack as follows:
Applicable Serial Numbers 11,001 and later

C-R board, complete 8-985-303-01 → C-R board, complete 8-985-303-11
N board, complete → Nn board, complete X-36302-98-1
VHF/AUDIO switch board → Ph board, complete X-30302-97-1

Note: New boards schematic and mounting diagrams are shown on pages 5 ~ 7, and their parts list are given on page 12.

5. MOUNTING DIAGRAMS OF Q AND W BOARDS

See page 8.

6. BLOCK DIAGRAM OF NEW C-R BOARD

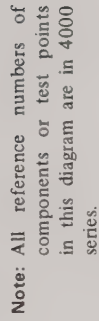
See page 8.

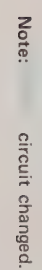
7. FRAME WIRING DIAGRAM — Main Chassis Section —

New frame wiring diagram including D-1 board, and additional audio monitor circuit is shown on page 9.

8. FRAME WIRING DIAGRAM — Record Pack Section —

These diagrams show the wiring modifications preventing a momentary loss of audio gain when switching from EXT to TV. See page 10.





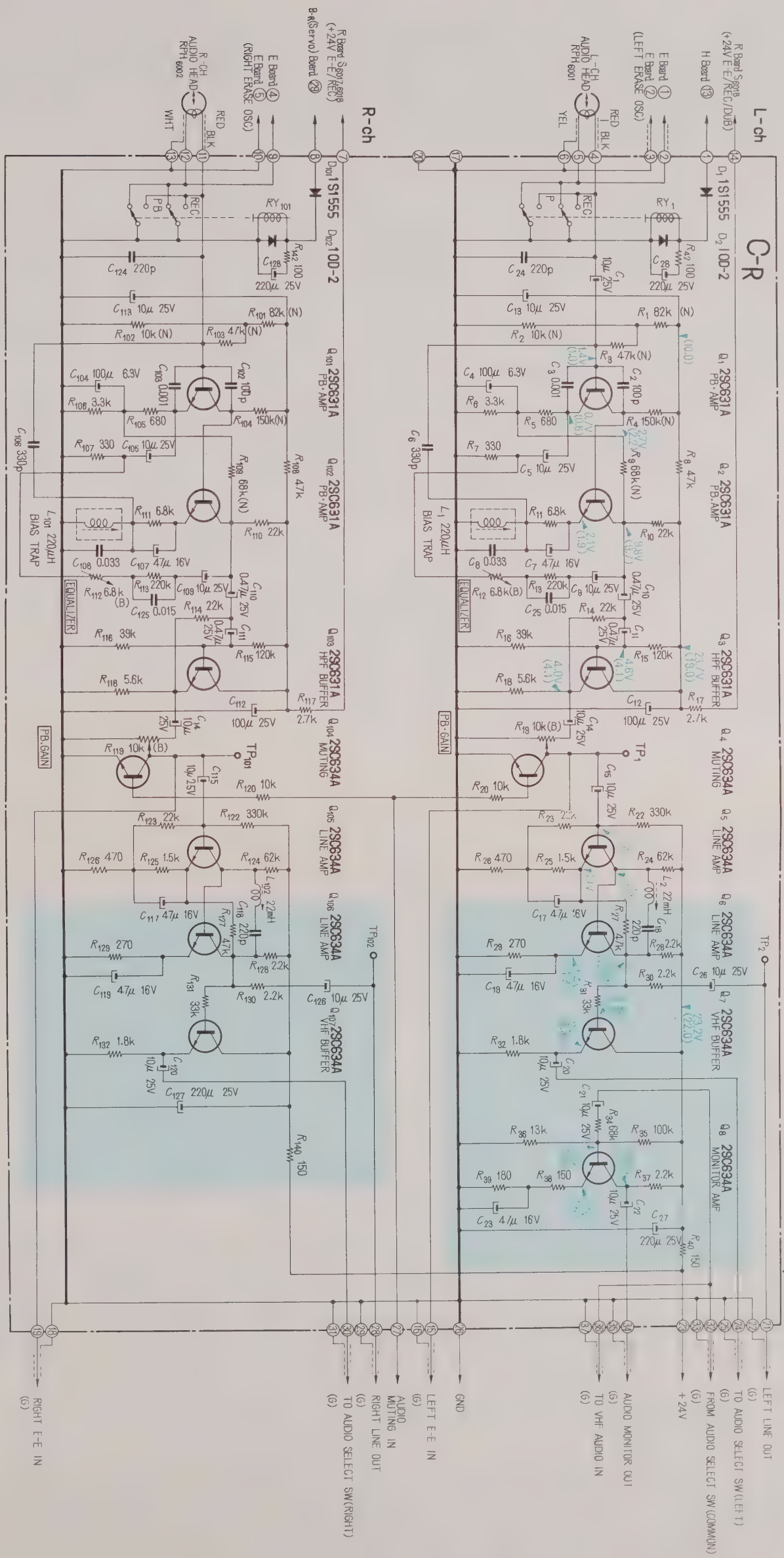
1. All reference numbers of components or test points in this diagram are in 4000 series.
2. All voltages are dc measured with a VTVM and should hold within $\pm 10\%$.
3. All resistance values are in ohms. $k = 1,000$, $M = 1,000k$
4. All capacitance values are in μF except as indicated with p, which means μF .

MOUNTING DIAGRAM

— C-R Board — (Serial No. 11,001 and later) Part No. 8-985-303-11

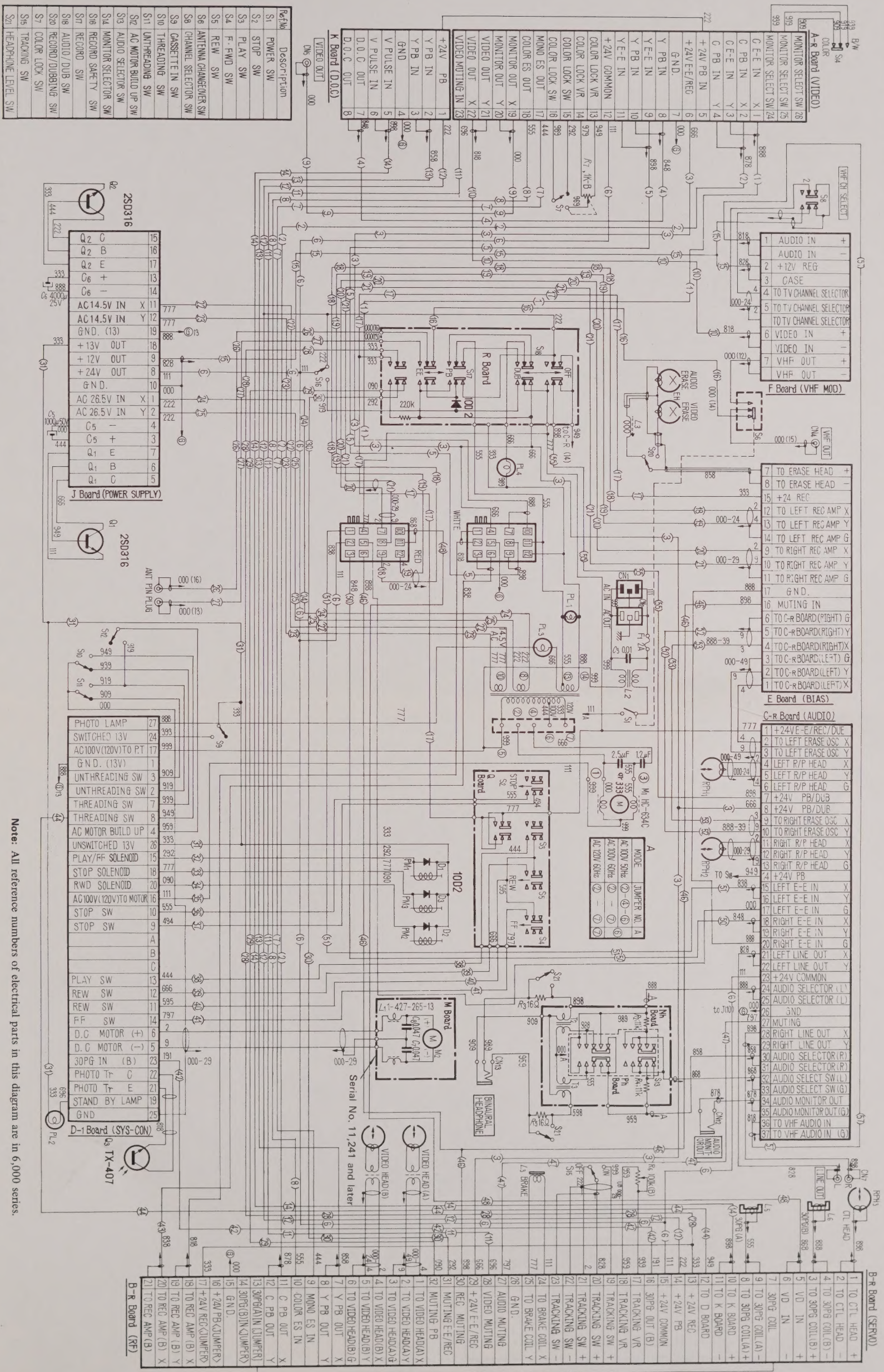


SCHEMATIC DIAGRAM
— C-R Board — (Serial No. 11,001 and later)



- Note:
1. All reference numbers of components or test points in this diagram are in 2000 series.
 2. All voltages are dc measured with a VTVM and should hold within $\pm 10\%$.
() represents the dc voltage measured with a VOM (20 k Ω /V).
 3. R-CH voltages are same as L-CH.
 4. Circuit changed.

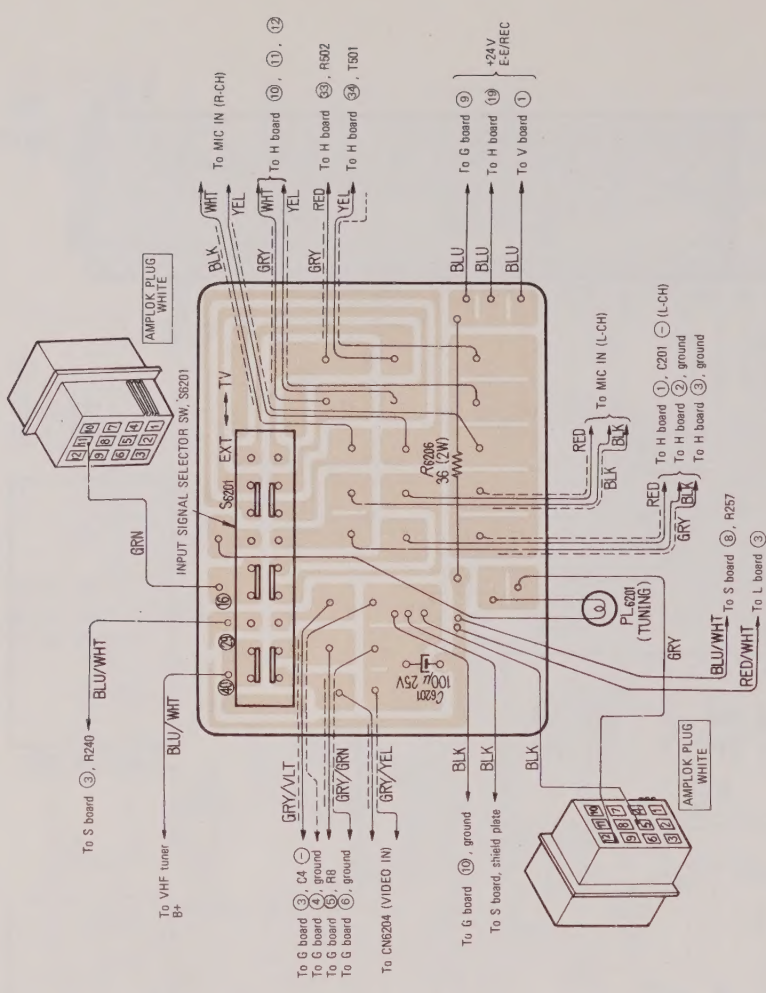
FRAME WIRING DIAGRAM — Main Chassis Section — (Serial No. 11,001 and later)



Note: All reference numbers of electrical parts in this diagram are in 6,000 series.

[illegible]

MOUNTING DIAGRAM – T Board –



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